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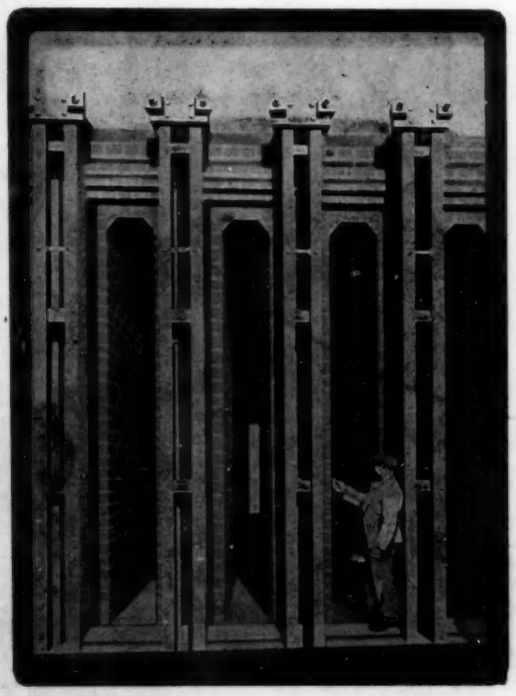

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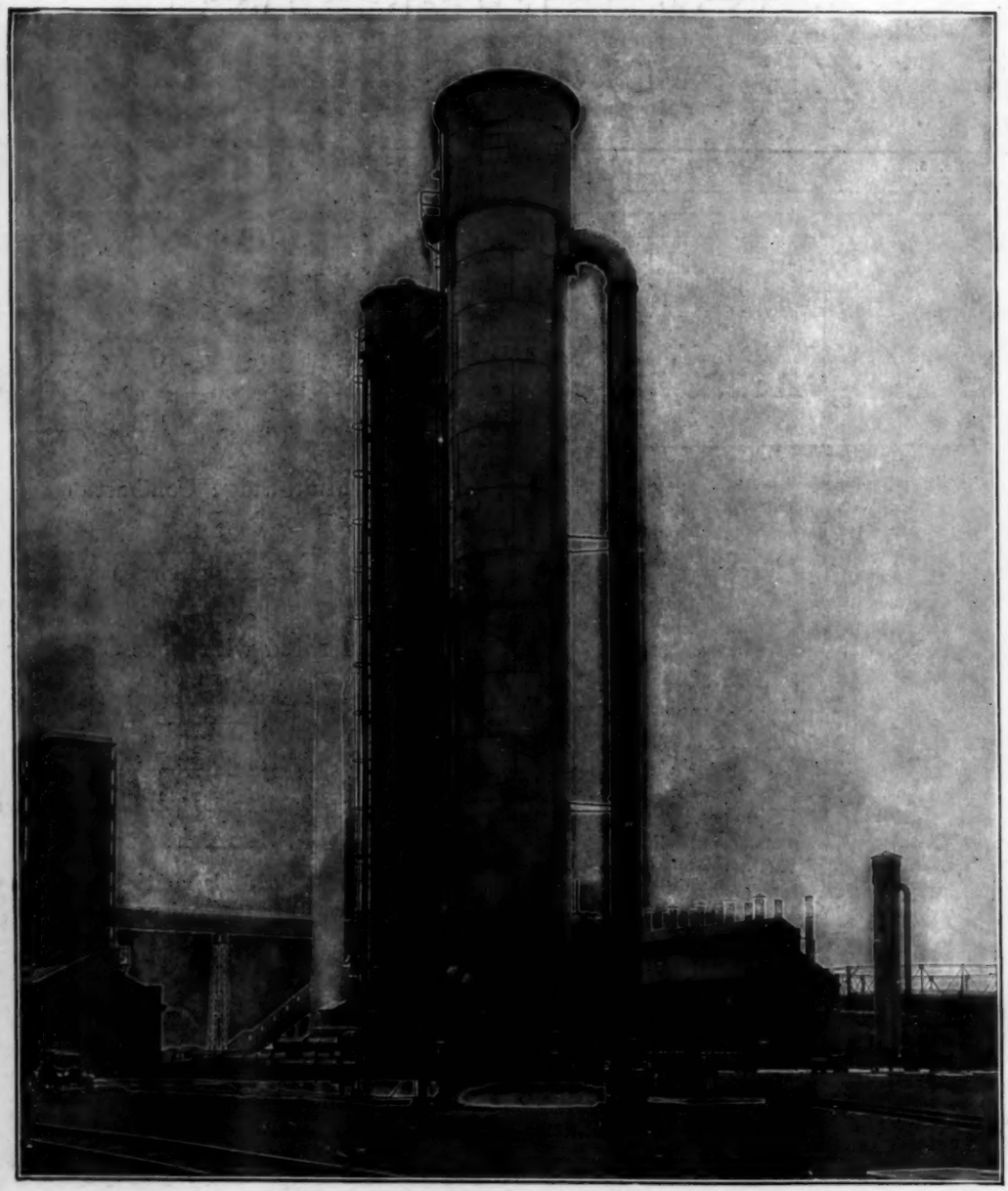

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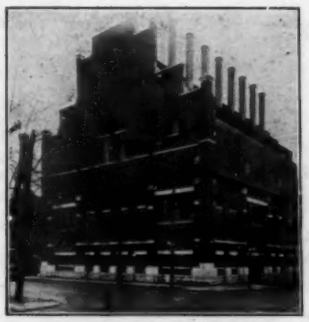

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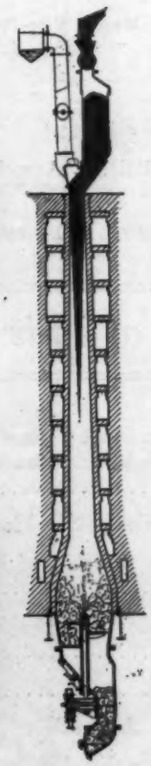

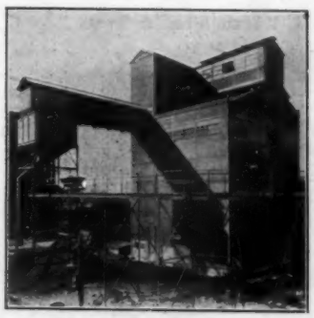

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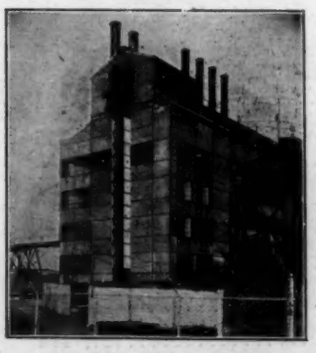

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AMERICAN
GAS JOURNAL

Established 1859— Pioneer of the Gas Industry

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The State of Existing Data on Heat Transfer Through Insulation in the Moderate and High Temperature Fields*

L. B. McMillan
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1. Introduction

THE purpose of this paper is to set forth briefly the state of existing knowledge on heat transfer through insulating materials in the moderate and high temperature fields as indicated by the literature on the subject; to show in what respects this knowledge is insufficient, and to point out the directions in which future research work is most urgently needed.

This is not a review of the literature in the sense of attempting to abstract various articles and statements. No such attempt has been made, but after a comprehensive survey of the literature, the endeavor has been made to present a complete picture of the information available and to point out what is lacking. In addition the effort is made in some cases to supply needed information not now available in the literature. In this connection the method of determining mean temperatures and the economic data in particular are entirely new and original. Furthermore, the whole subject is presented from a new point of view.

Dr. L. B. McMillan

The particular field of this research is the literature referring to heat transfer through insulation in the temperature range between the refrigeration field on the one hand and the refractories field on the other, with the specific exception of literature pertaining to heat transfer through building materials.

Definition of Symbols

x = thickness of insulation.
x_1 = thickness of first material.
x_2 = thickness of second material.
x_3 = thickness of third material.
k = conductivity—(B.t.u. per sq. ft. per deg. temp. diff. between surfaces per 1 inch thick per hour).
k_1 = conductivity of first material.
k_2 = conductivity of second material.
k_3 = conductivity of third material.
S = shape factor.
t_o = temperature of air on warmer side of insulation.
t_1 = temperature of warmer surface of insulation.
t_2 = temperature of cooler surface of first material.
t_3 = temperature of cooler surface of second material.
t_i = temperature of air on cooler side of insulation.
c = rate of heat transfer from air to surface or from surface to air.
c_1 = rate of heat transfer from air to surface.
c_2 = rate of heat transfer from surface to air.
R = resistance.
R_s = surface resistance.
r_1 = inner radius of insulation.

* Presented at the Heat Transfer Session arranged by the National Research Council Committee on Heat Transmission at the Annual Meeting of the American Society of Mechanical Engineers, in joint session with the American Society of Refrigerating Engineers, 29 West 39th Street, New York City, December 7, 1926.

r_2 = outer radius of first material.
r_3 = outer radius of second material.
r_x = outer radius of any layer of material.
r_s = radius of outer surface of insulation.
U = over-all rate of heat transfer per hour.
U_1 = over-all rate of heat transfer per sq. ft. of pipe surface per hr.
U_2 = over-all rate of heat transfer per sq. ft. of surface at radius per hr.
U_s = over-all rate of heat transfer per sq. ft. of outside surface per hr.
W_R = rate of heat transfer from surface by radiation, B.t.u. per sq. ft. per hr.
W_C = rate of heat transfer from surface by convection, B.t.u. per sq. ft. per hr.
W_{CV} = rate of heat transfer from surface by convection, B.t.u. per sq. ft. at any vel.
T_1 = absolute temperature of hot surface.
T_2 = absolute temperature of surrounding objects.
T_a = absolute temperature of air.
E = emissivity.
V = air velocity, ft. per min.
Y = hours of operation per year.

$$a = \frac{Y\,(t_s - t_a)\,M}{1{,}000{,}000}$$

b = cost of insulation in dollars per sq. ft. per 1 inch thick per year.
M = value of heat in dollars per million available B.t.u.

2. Definitions and Equations

The fundamental theory of heat transfer in the steady state (uniform temperature conditions maintained at both warmer and cooler surfaces) has been well known throughout the past century by the leading authorities on heat transfer. Briefly, it is based on the same conception as Ohm's law; namely, that flow varies directly as the potential and inversely as the resistance. On the other hand, the lack of such thorough understanding of basic principles by many who have written on the subject is responsible for the state of the literature which, by some, is considered chaotic. The author is not inclined to such a gloomy view of the entire literature, however. It is true that in referring to the literature one must be able to differentiate between the sound and the unsubstantial, but this is also true of the literature of any subject, where it is as voluminous as in this case.

Case I. Simplest Heat Transfer, Flat Surfaces. The resistance to heat transfer is dependent upon the thickness, x, and conductivity, k. It varies directly as the thickness and inversely as the conductivity and is equal to x/k. Therefore, the simplest case of heat transfer through a material having flat surfaces is represented by the equation,

$$U = \frac{t_1 - t_2}{\frac{x}{k}} \qquad (1)$$

in which U is the overall rate of heat transfer in B.t.u. per square foot per hour, t_1 is the temperature of the warmer surface and t_2 is the temperature of the cooler surface.

Conductivity. Thermal conductivity is defined as rate of heat transfer in one direction (in a direction perpendicular to an area) per unit area, per unit temperature differential per unit thickness, per unit time (B.t.u. per square foot, per degree temperature difference between surfaces per 1 inch thickness, per hour).

Conductivity is a specifice property of a material. It is not dependent on the area, thickness or shape of the material. It is the same for a 0.1 inch thickness of the material as it is for a 10-inch thickness. It is the same for a uniform material whether the material is on a pipe or on a flat surface. It is a *rate*, not a *quantity*. The total quantity of heat transmitted is dependent upon the area, shape and length of path (thickness of material), but conductivity is not. Conductivity is dependent upon temperature, but this is also true of other specific properties of material, density for example. This relationship of conductivity and temperature will be discussed in detail later in this paper.

The phrase, *in one direction*, has been added to the usual definition of conductivity for two reasons. First, because some materials, wood for example, may have different conductivities in different directions; and second, and more particularly, to warn the unwary to take account of conditions involved on curved surfaces in the portion of the equation dealing with the shape of the path and not in the conductivity itself. The scientist does not heed this phrase in his definition. To him it is so obvious that it goes without saying, but reference to the literature shows that many who have written on this subject have had a conception of conductivity that is fundamentally wrong.

Case II. One Material and One Surface Resistance. Flat Surface. Often the temperature of the cooler surface is not known, the known temperature being that of the warmer surface, t_1, and that of the air surrounding the cooler surface, t_a. Then the rate of heat transfer is given by the equation

$$U = \frac{t_1 - t_a}{\frac{x}{k} + \frac{1}{c}} \qquad (2)$$

in which c is the rate of heat transfer from outer surface to air.

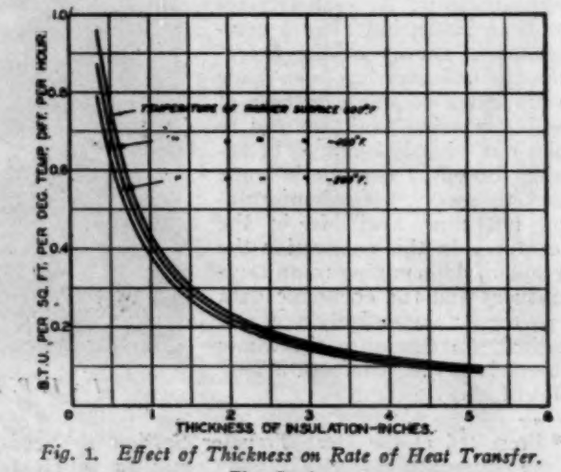


Fig. 1. Effect of Thickness on Rate of Heat Transfer. Flat Surfaces.

The manner in which rate of heat transfer varies as the thickness of the insulation is increased is illustrated in Fig. 1, which is based on the conditions of Case II. It will be noted that the transfer through 2-inch thick material is somewhat greater than half of that through

1-inch thick material. The reason for this is clearly apparent in Equation (2). Doubling the thickness doubles the value of the term x/k, but does not double the value of the term 1/c. Consequently, since the value of the denominator in the case of 2-inch thickness is somewhat less than double the value for 1-inch thick, the value of U for 2-inch thick material must be somewhat more than one-half of its value for 1-inch thick material.

Surface Resistance. The term x/k represents the resistance of the material in question and the term 1/c represents the *Surface Resistance.* The lack of thorough understanding of the effect of surface resistance is perhaps responsible for more confusion in the literature of heat transfer than any other single item. The failure to separate the effects of *surface resistance* from those of *insulation resistance* is the cause of most of the conflicting conceptions of conductivity.

In some cases surface resistance is the controlling factor in total rate of heat transmission. For example, in the case of a ¼-inch thickness of a metal having a conductivity of 2,500 B.t.u. per square foot, per degree temperature difference between surfaces per 1-inch thickness, per hour, and with a temperature difference of 1 degree Fahrenheit between surfaces, the rate of heat transfer per square foot, per hour would be

$$\frac{1}{\frac{0.25}{2500}} = 10{,}000 \text{ B.t.u.}$$

If, however, the temperature difference between the warmer surface and still air surrounding the cooler surface is 1 degree Fahrenheit, and the rate of heat transfer from surface to air is 2.0 B.t.u. per square foot per degree temperature difference per hour, the total heat transfer per square foot per hour would be

$$\frac{1}{\frac{0.25}{2500}+\frac{1}{2}} = \frac{1}{0.0001+0.5} = 1.9996 \text{ B.t.u.}$$ (or for all practical purposes = 2.0 B.t.u.)

In this case the surface resistance is 99.98 per cent of the total and the resistance of the metal is practically negligible. In such a case a variation of 100 per cent in the conductivity item would have no appreciable effect on the total.

On the other hand, in the case of well insulated surfaces, surface resistance is a very small part of the total. For example, in the case of a 10-inch thickness of a material having a conductivity of 0.25 B.t.u. per square foot, per degree temperature difference per 1-inch thickness, per hour, and with a temperature difference of 1 degree Fahrenheit between surfaces, the rate of heat transfer would be $\frac{1}{\frac{10}{0.25}} = 0.025$ B.t.u. per square foot per hour.

If the temperature difference between the warmer surface and still air surrounding the cooler surface is 1 degree Fahrenheit, and the rate of heat transfer from surface to air is 2.0 B.t.u. per square foot per degree temperature difference per hour, the rate of heat transfer would be

$$\frac{1}{\frac{10}{0.25}+\frac{1}{2}} = \frac{1}{40+0.5} = 0.0247 \text{ B.t.u. per sq. ft. per hr.}$$

In this case the surface resistance is only 1.25 per cent of the total.

In the first example, neglecting to take account of surface resistance would make the result 5,000 times too large. In the second example, the surface resistance influences the result only to the extent of about 1¼ per cent. These are representative of the two extremes, but actual cases will be found in practice over this entire range and at times even more extreme cases will be encountered.

This illustrates the importance of surface resistance. The matter would be greatly simplified if surface resistance were a relatively constant quantity, but it is not. It is influenced by the temperature of the surface, the temperature of surrounding objects, the nature of the surface, the position of the surface, the velocity of air currents over the surface, and by many other causes. Fortunately for the solution of insulation problems the value of surface resistance is usually small as compared with the insulation resistance—usually less than 25 per cent, and frequently less than 10 per cent of the insulation resistance. Therefore, with even approximate data on surface resistance such problems may be solved with a very satisfactory degree of accuracy.

But the case of heat transfer from bare surfaces at high temperatures and at varying air velocities is quite another matter. It would be difficult to find a more interesting or more fruitful field for physical research. But if such research is to be of permanent value it must be directed along other lines than those generally followed in the past. It must take into account the absolute temperatures of the surface and surrounding objects and it must take separately into account the effects of radiation and convection, and the effect, on the latter, of air velocity, and extent and position of the surface. The work of Langmuir[1] is an excellent illustration of the direction in which to proceed, but the work must be carried much farther if the results are to be of real service in the engineering field.

Case III. One Material, Two Surface Resistances, Flat Surface. When the temperature of neither the inner nor outer surface is known, and the known temperatures are those of the air on either side of the insulation, the equation for heat transfer is

$$U = \frac{t_o - t_a}{\frac{1}{c_1}+\frac{x}{k}+\frac{1}{c_2}} \quad (3)$$

in which t_o is the temperature of the air on the warmer side, c_1, is the rate of heat transfer from air to surface on the warmer side and c_2 is the rate of heat transfer from cooler surface to surrounding air.

The inside surface resistance, $1/c_1$, is not used when the temperature of the warmer surface is known. Also, its magnitude is often negligible where effective insulation is placed directly against a heated surface the tem-

[1] Transactions American Electrochemical Society, Vol. 23.

perature of which is known. However, it is included in these general equations in order that it be not neglected in cases where it should be taken into account.

Case IV. Two or More Materials, Flat Surface. So far, only one material has been considered. If heat must flow successively through two or more different materials the equation takes the form

$$U = \frac{t_o - t_a}{\frac{1}{c_1} + \frac{X_1}{K_1} + \frac{X_2}{K_2} + \frac{X_3}{K_3} + \frac{1}{c_2}} \quad (4)$$

in which x_1, x_2, x_3, etc., are the thicknesses of the various materials and k_1, k_2, k_3, etc., are the conductivities of the respective materials.

Inspection of Equations (1) to (4) shows that they are all of the same form. When heat must flow successively through various elements of the construction, in order to write the equation for heat transfer, all that is necessary is to add to the equation an item representing the resistance of each successive element.

Cylindrical Surfaces[1]. Except on flat surfaces the internal resistance of a material does not vary directly as the thickness. In the case of cylindrical surfaces, increasing the thickness supplies additional resistance through which the heat must flow, but at the same time increases the area of the path through which the heat may flow. This is illustrated in Fig. 2, which shows

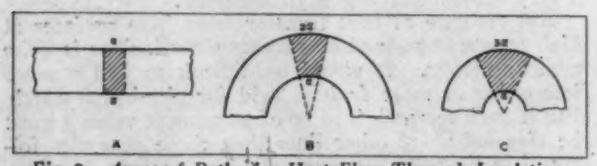


Fig. 2. Areas of Paths for Heat Flow Through Insulations on Flat and Cylindrical Surfaces.

the areas of paths for flat and cylindrical surfaces. It is clearly apparent from this diagram that the heat transfer per unit of area of inner surface will be greater for insulation on a curved than on a flat surface, and that the smaller the radius of curvature, the greater will be the rate of heat transfer per unit of inner surface area.

Case V. One Material—Cylindrical Surfaces. The rate of heat transfer per hour, per square foot of outer surface, through a single layer of uniform material on a cylindrical surface, when the temperatures of the two surfaces are known, is given by the equation

$$U_2 = \frac{t_1 - t_2}{\frac{r_2 \log_e \frac{r_2}{r_1}}{k}} \quad (5)$$

in which t_1 and t_2 are the temperatures of the warmer and cooler surfaces respectively, r_1 is the external radius of the pipe or cylinder and r_2 is the radius of the outer surface of the insulation.

The loss per square foot of pipe surface is

$$U_1 = \frac{r_2}{r_1} \times U_2 \quad (5a)$$

in which U_1 and U_2 represent the rates of heat transfer per hour per square foot of pipe surface and outer surface of insulation respectively.

Equation (5) might have been written to give transfer per square foot of pipe surface directly by substituting $r_1 \log_e \frac{r_2}{r_1}$ where $r_2 \log_e \frac{r_2}{r_1}$ appears. However,

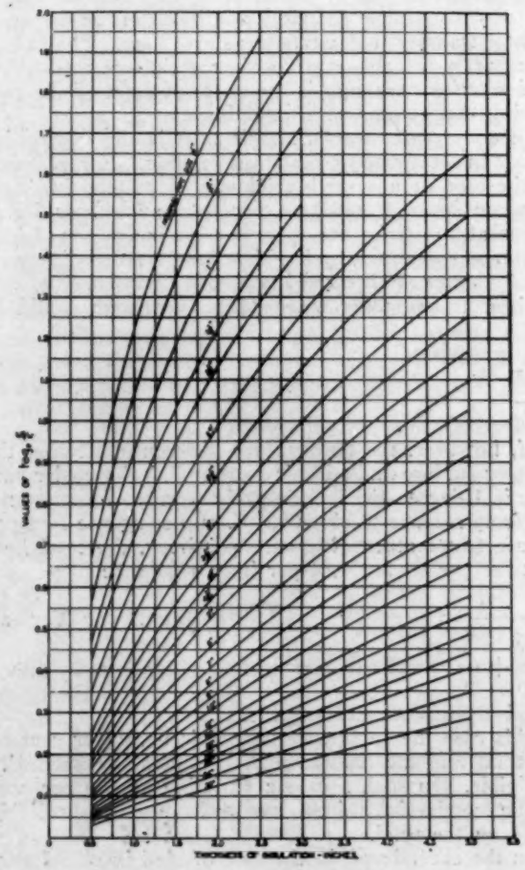


Fig. 3. Values of $\log_e \frac{r_x}{r_1}$

the reason for giving preference to the form of equation which results in loss per square foot of outer surface will be apparent in connection with subsequent equations involving surface resistance. The surface resistance most frequently applies to that surface; therefore, it is more convenient to calculate the rate of transfer per square foot of outer surface. Then the loss per square foot of pipe surface is easily calculated from U_2 by means of Equation (5a).

It will be noted that the expression $r_2 \log_e \frac{r_1}{r_2}$ occupies the same position in Equation (5) that the thickness,

[1] Equations of the type of (5) to (8a) inclusive were outlined by the author in a discussion in Journal A.S.H. and V.E., July, 1920, p. 571.

x, occupies in Equation (1). In fact, this expression is frequently referred to, for convenience, as "equivalent thickness." It is numerically equal to the thickness of material on a flat surface which would be required to give the same rate of heat transfer as that per square foot of outer surface of insulation on the cylinder or pipe. With this fact in mind, a like relationship will immediately be apparent between Equations (6), (7) and (8), which follow, and the corresponding equations for flat surfaces applying to similar conditions. Therefore, these equations are not nearly so formidable as they appear.

In fact, using values of $\log_e \frac{r_x}{r_1}$ shown in Fig. 3, the solution becomes very simple. r_x is the outer radius of any layer of insulation and in the case of a single material, $r_x = r_2$.

Case VI. One Material, Cylindrical Surface. One Surface Resistance. When the temperature of the cooler surface is not known the equation becomes

$$U_2 = \frac{t_1 - t_a}{\frac{r_2 \log_e \frac{r_2}{r_1}}{k} + \frac{1}{c}} \quad (6)$$

In the preceding equation all terms have the same significance as in Cases II and V respectively.

To obtain rate of heat transfer per unit of pipe surface use Equation (5-a).

The effect of pipe size on the rates of heat transfer through insulation per square foot of pipe surface under the conditions of Case VI, is illustrated in Fig. 4. It

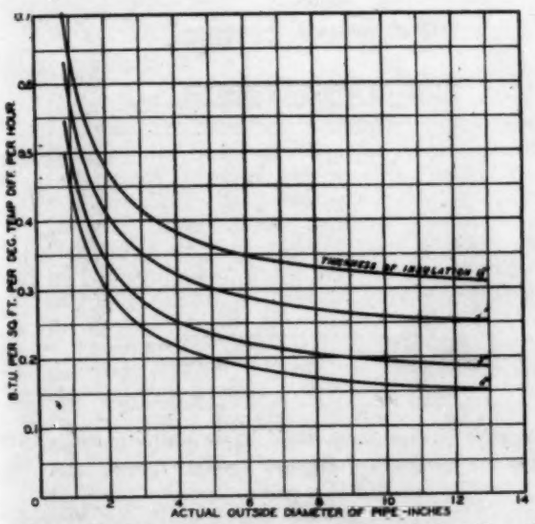


Fig. 4. Variation With Pipe Size of Rate of Heat Transfer Through a Given Thickness of Insulation.

will be noted that the rate of heat transfer through 2-inch thick insulation on ½-inch pipe is more than twice as great as that through the same thickness of insulation on 12-inch pipe.

Case VII. One Material, Cylindrical Surface, Two Surface Resistances.

$$U_2 = \frac{t_o \quad t_a}{\frac{r_2}{r_1} \times \frac{1}{c_1} + \frac{r_2 \log_e \frac{r_2}{r_1}}{k} + \frac{1}{c_2}} \quad (7)$$

in which all terms have the same significance as in Case III and V respectively.

$$As\ before\ U_1 = \frac{r_2}{r_1} \times U_2$$

Case VIII. Two or More Materials, Cylindrical Surfaces, Two Surface Resistances.

$$U_s = \frac{t_o - t_a}{\frac{r_s}{r_1} \times \frac{1}{c_1} + \frac{r_s \log_e \frac{r_2}{r_1}}{k_1} + \frac{r_s \log_e \frac{r_3}{r_2}}{k_2} + \frac{r_s \log_e \frac{r_4}{r_3}}{k_3} + \cdots + \frac{1}{c_2}} \quad (8)$$

$$U_1 = \frac{r_s}{r_1} \times U_s \quad (8a)$$

in which r_s is the radius of the outer surface of insulation and U_s is rate of heat transfer per hour per square foot of this surface. Other terms have the same significance as in previous equations.

Fig. 3 may be used for the evaluation of the logarithmic terms in combination of materials as well as for single materials. In the case of two materials

$$\log_e \frac{r_3}{r_2} = \log_e \frac{r_3}{r_1} - \log_e \frac{r_2}{r_1}$$

Therefore, in such cases, the values of the logarithmic terms are readily found by reading from the chart the value of the logarithmic term corresponding to the entire thickness and subtracting from this the value of the logarithmic term corresponding to the thickness of the first layer. Both of these values may be read from the chart and their difference referred to above is the value of the logarithmic term for the second layer.

Temperature at Any Point. The temperature drop through each element of the construction bears the same ratio to the total temperature drop as the resistance of that element bears to the total resistance. Therefore, since the terms in the denominator of each of Equations (2), (3), (4), (6), (7) and (8) are the respective resistances to heat flow offered by the individual elements in the construction, this form of equation lends itself very conveniently to the calculation of the temperature at any point in the construction.

Small Cylinders. In the case of small cylinders, such as wires, the increased area of path for heat flow through covering material often overbalances the added resistance through which the heat must flow. In such a case, applying material on the surface of the cylinder will increase the loss until the thickness has been built up to the point where the outside radius

$$r_2 = \frac{k}{c} = R_s k \quad (9)$$

(Continued on page 114)

Office Methods in Gas Companies*

VIII. Handling changes in records

G. L. Harris

IN planning the organization of any office there are two important facts that should constantly be kept in mind. And especially is this true in the organization of office routine in the gas company. First, we can be sure that our office records are never so complete that we can feel satisfied to leave them as they are. Even if they are absolutely correct today, they will need revision and correction tomorrow, because these records represent a cross section of human life and human activity. And since this is so there is sure to be constant change, constant fluctuation in the records.

Second, errors are certain to be made by both the employees and the customers, and these errors are certain to get into the records. They will come to light constantly, unceasingly, from all sections of the company and from every aspect of customer relationship.

This situation is to be expected. It is a normal evidence of life and growth. The fact that errors occur in the record is not serious. It is the failure to correct these errors, the failure to make the proper adjustments, that is serious.

Possibly the greatest weakness in office practice today is this neglect in providing a systematic procedure for making adjustments to records which have already been set up. We go to great pains to design a perfect service order routine or purchase order routine, and then we fail to set up a method of correcting errors which occur in the daily operation of that routine.

An error in the records should not cause confusion. It should have been anticipated and provided for in advance. It should be handled as automatically as was the original situation which caused the entry to be made in the records. In this article we shall discuss changes in records which must continually be made in any live and growing gas company, and we shall suggest methods of handling these changes so as to eliminate worry within the company and friction with customers of the company.

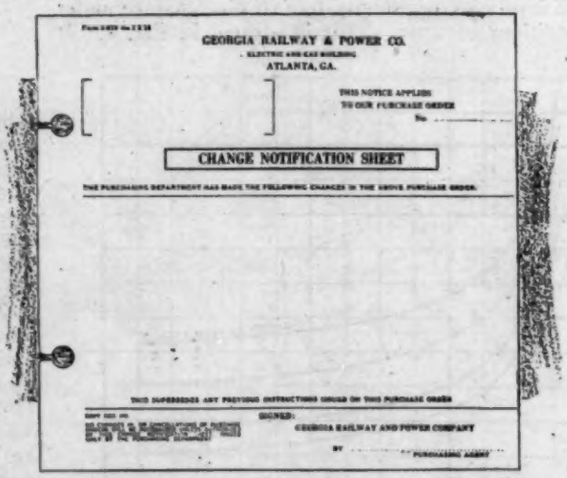
Purchase Order Changes

Let us consider this problem first as it applies to the purchasing department of the gas company. The purchasing official sets up a definite purchasing routine. Requisitions are issued by departments within the company, and are forwarded to the purchasing department. Prices are secured and a purchase order is issued in a predetermined number of copies. Usually one copy goes to the vendor, one to the company storekeeper, one to the department requisitioning the material, one to the auditor, one or two to clerks in the purchasing department.

And then, very often, after the purchase order has been issued, there must be a change made in it. There are many justifiable reasons for changes in purchase orders: The vendor may not be able to fill the entire order; he may advise the purchase of a different quantity than the order calls for, in order to secure a better package price or a better freight rate; price changes may be necessary; the entire order may have to be cancelled.

A purchase order routine, therefore, which does not provide a regular method for controlling changes in purchase orders, is certain to be weak at a vital point.

No purchase order should ever be changed except by instructions from the purchasing department. But when an order is changed the change should be made systematically and thoroughly. A regular


GEORGIA RAILWAY & POWER CO.
ATLANTA, GA.

THIS NOTICE APPLIES TO OUR PURCHASE ORDER No. _____

CHANGE NOTIFICATION SHEET

THE PURCHASING DEPARTMENT HAS MADE THE FOLLOWING CHANGES IN THE ABOVE PURCHASE ORDER.

THIS SUPERSEDES ANY PREVIOUS INSTRUCTIONS ISSUED ON THIS PURCHASE ORDER

SIGNED:
GEORGIA RAILWAY AND POWER COMPANY
BY _____ PURCHASING AGENT

The Change Notification Sheet should be the same size and shape as the purchase order but of a different color.

form should be provided, and the change notice should be sent to every place where a copy of the original purchase order went. The change notification sheet shown here has proved very effective. Note particularly the statement reading: "No changes in, or cancellations of purchase orders will be recognized unless authorized by this change notification sheet, issued only by the purchasing department."

* This is the eighth of a series of articles by Mr. Harris. The ninth will appear in an early issue.

The purchasing department of every gas company should have and should use a form such as this, as an integral part of the purchase order routine.

Sales Order Changes

If care should be taken in changing purchase orders, it is even more important that detailed provision be made for changing sales orders. In this case the gas company is the vendor, not the customer, and the customers must be pleased.

When a gas appliance is sold the sales order is made out in several copies. One copy goes to the customer, one to the service department, one to the auditor, one to the sales department file, possibly one to the credit department. And very, very often after these copies have been despatched, a change must be made in the sales order. The customer has just learned that something additional is needed, or the customer wants to wait a few days before having the appliance delivered, or the salesman has made a mistake in arranging for payments. All of these are legitimate reasons for changing the sales order, and any sales manager in a gas company could think of many more possible reasons.

Consequently, there must be a change notification sheet provided for sales orders, and in case an order is changed one copy of this sheet must be sent to every one who received a copy of the original order. The supervision of this procedure should be definitely placed in the hands of one employee in the sales department, and all changes should be made on the authorization of this employee only.

Changes in Customer Records

The illustrations given thus far apply principally to records within particular departments of the gas company, and are best handled by the departments themselves. But there is a far more extensive class of record changes than this, namely, changes which affect the records of the company's customers. These changes may originate with the customers, or they may originate with the employees of the company. They may affect only one department or record, or they may affect several departments and several different records.

The meter reader often discovers an error in the meter number on his records. If he merely changes the number in his book he is possibly storing up future trouble for the company. The record should be changed on the customer's service card, on the customers' ledger, and in the meter records themselves.

What should the meter reader do? Or what should he do if the customer mentions to him that the gas bill is not being received? Or if the customer tells him that his house number has been changed?

What should the receiving teller do if a customer, while paying his bill, tells him that in future he would like to have his bill mailed to a different address than in the past? Or suppose the repair man who is out adjusting a range is told that the customer's name is misspelled on the bills he receives from the company?

These are not merely suppositions. Every one of them occurs time after time in every gas company. We must remember that any employee whom the customer happens to meet is to that customer the entire company. And not only is this true with uneducated customers. It is not at all uncommon for an executive of the gas company to be told by some one whom he has met socially that there is an error in the company's records as they pertain to that particular person.

Each customer is in his own mind an individual case in the records of the company. And each customer looks upon the particular employee whom he happens to meet as the proper person to tell of his relations with the company.

The telephone clerks, counter clerks, salesmen, floor men, collection clerks, even the officers and executives are constantly receiving notices of changes which should be made in the records. All too often these employees have no idea what to do, to whom to report the situation. Or they tell themselves that the matter does not concern them, and proceed to forget it.

As a result when the customer next meets an employee of the company he tells how he has been slighted and neglected because the change he requested has not been made. He is still getting his bills at his home instead of at his office. Or the meter reader is still failing to call next door for the key as he was told to do.

Good-will? All through these articles we have emphasized the value of customer good-will. We have pointed out, in our discussion of each routine, the effect on the customer made by a smoothly functioning office.

Here then is one of the greatest potential factors in securing customer good-will and appreciation. Let every employee be capable of handling a correction in the customer's record, whether that employee be a meter reader or a vice-president. Let us set up a procedure that will take advantage of every meeting we have with our customers, and that will systematically handle any suggestion the customer may make as to adjusting our relations with him.

The Change Routine

There are so many angles to look after when we are changing our records as they apply to our customers that some one who is thoroughly familiar with the entire organization should be in charge of record changes. This one person should know that a change in mailing address needs to be recorded in the service record, in the ledger, in the deposit record, and in the addressograph record. He should know that a change in the spelling of a customer's name is important, and that this change must be made everywhere in the company where there is a record of that customer. And he should see to it that the change is not only reported to the proper places, but that the change is actually made in those places.

We recommend first that such a central change agency be established, and that all changes which apply to customers' records be reported to that agency.

Every employee in the company should have in his possession, or should have access to, a change notification form. He should be required to fill this form out for every change which comes to his attention, and to forward it to the central change department. The form need not be complicated. It should show the customer's name and address, and the nature of the change which is to be made, and it should be signed by the person making the report.

When this notice is received by the central change clerk, that clerk should decide just which records in the company are affected by the change. He should make out one copy of the change notice for every record concerned, and should send this copy to the person in charge of the particular record.

One copy of the notice should be kept by the change clerk and it should be held in a follow-up file until every copy of the change notice has come back with a notation that the proper change has been made in the records.

The entire matter is very simple, yet it is a matter of vital importance, and such an arrangement will result both in saving of time and in an assurance of good-will from the customers affected. It will save the executive's time, for he will simply fill out a change notice and forget it. And it will enable even those clerks who are unfamiliar with the company routine to serve as official representatives of the company.

The ideal toward which every gas company should strive, and toward which the plan outlined in this article is a definite step, is for every employee of the company—at any and all times—to be capable of taking a message from any customer and of adjusting the matter to the customer's satisfaction. In short it is a long step toward our most valuable asset —Good-will.

Drama and Comedy in Utility Service

Appliance merchandisers as utility missionaries have varied experiences

Glenn R. Trumbull
New Business Manager, Fitkin Utilities

SIDELIGHTS were thrown on the comedy and romance of electric and gas appliance merchandising by Glenn R. Trumbull, new business manager for the General Engineering and Management Corporation, who operate the Fitkin Utilities.

"We stumble into some funny things now and then," Mr. Trumbull said. "The lady with the Dublin brogue, for instance, who sent back an electric washing machine because, as she explained, the whirring paddles hurt her feet every time she tried to take a bath.

"Our particular job is to carry the message of comfort and happiness into the homes of our customers. We handle almost every kind of gas and electric appliance which has proven meritorious, particularly those designed to save work and worry in housekeeping. We sell flocks of gas and electric ranges, water heaters, room heaters, irons and ironers, toasters, gas and electric refrigerators, coffee percolators, heating pads, all sorts of lamps, hair-curlers, fixtures, and gobs of other little devices too numerous to mention.

"We rank, perhaps, as a sort of public utility missionary, carrying the gospel of 'we-do-it-better' into all sorts of dark places. We make converts quite readily, too, inasmuch as last year we did a gross merchandising and new power business of more than $2,750,000.

The Plaint of Mrs. Newly-wed

"Sometimes, however, the converts backslide, and then we have to convert them all over again. It is our department which has to explain to the new housewife just why she can't cross the wires and cook on her radio while the kitchen range delivers a jazz concert.

"From one of the Kansas properties, for instance, comes the story that Mrs. Newly-wed called up the company office and complained wailingly that pungent smoke was rolling out of her range oven but that by the cook book her pie still had ten minutes of baking. We didn't laugh at her plight. We took it very seriously and explained just how to control the oven heat automatically.

"It is surprising how the new generation takes to gas and electrical appliances. Recently in the course of an analysis it was revealed that most of the newly married couples immediately equip their homes fully with these labor-savers. And within a few months we are called on to install almost identical equipment in the homes of the brides' parents. The mothers-in-law come to visit and stay to marvel, and then they go home and do the modern likewise.

New Generation "Up-to-the-Minute"

"The new generation scoffs at wash tubs and coffee pots and brooms, as well as coal stoves and coal furnaces. The bride of today wants lots of lamps. She wants lots of light on walls as well as on subjects. She realizes her attractiveness as she sits across the breakfast table and deftly coddles the eggs and browns the toast and percolates the coffee—all so quickly and satisfactorily. And she knows every tithe of the value of sitting behind those polished, silvery appliances which carry such an irresistible pleasure-appeal to her mate across the table. She realizes that she is directly coupled, in this manner, with her husband's pleasant breakfast, and she has just this much greater opportunity of revealing her deft and dexterous grace as she caters to his wants at this difficult meal.

"The American girl is quick to enhance her charms, and she has seized on the electrical breakfast—cooked at the table—as part of her stock in trade."

Selling Gas Ranges According to Sizes of Kitchens and Families

Some worthwhile suggestions

Frank H. Williams

WHAT is the most effective sales argument the salesman has in putting across the sale of a gas range?

This question was put recently to a number of live wire and very successful range salesmen and from them some very interesting and worthwhile information was secured. Out of the replies received it was found, with some surprise, that heavy emphasis had been laid by several of the salesmen on the proposition of making prospects see that the ranges the salesmen were trying to sell them were just exactly the right sizes for their kitchens and their families. And in this proposition of selling gas ranges according to sizes of kitchens and families there may be a suggestion or two which will be of aid to other salesmen in putting more sales of ranges across.

Alert Salesman's Idea

One alert salesman explained the proposition in this way:

" I find that, generally, the average prospects have their minds made up pretty well in advance as to just what sort of gas range they will purchase and their determination is reached by their pocketbooks. In other words, they buy ranges according to prices and not primarily according to sizes and adaptability to their families and kitchens.

"The salesman, then, in such cases is up against a rather difficult proposition because, unless he can think of some unusual sales argument, it is simply a proposition of letting the prospects sell themselves. If the prospects like the ranges the salesman shows to them and if there is some range that is just about the price they want to pay, they will probably buy it. Otherwise no sale is made, in all probability.

"It hurts the average salesman to see a couple walk out of the office without buying a range when it is perfectly evident that they are really in the market for a range and when the salesman feels that if he could only hit on the right sales theme he could put the sale across easily enough.

"That sort of thing used to happen to me every now and then—quite frequently, in fact. But it's a long time since I've lost a sale through my inability to say the right thing to folks who were of this type; who have their mind made up in advance as to just about what they'll pay for a range and who intend buying a range on the price basis alone.

"Now when I find myself facing a proposition of this sort and when I find that the prospect isn't exactly pleased with what I'm showing, I say something like this:

" 'Nowadays a great many people judge the sort of range they should buy by the size of their kitchen and by the size of their family. For instance, if there are only two or three people in the family with few prospects of any more people being in the family then, of course, a smaller range will serve that family even better than a big range. And, again, if there is just a certain size place in the kitchen and a large family, then a range of a certain type may be just the thing while ranges of other types may not be the thing at all.

" 'Now if you can give me some data about your family and about your kitchen perhaps I can be of even more help to you in picking out just the sort of range you should have.'

Average Prospect Generally Impressed

"This line of talk generally makes a deep impression on the average prospect because, in all likelihood, the prospect hasn't had any thought of gauging the size of the range by the size of the kitchen or the size of the family. So the prospect furnishes me with some additional information about the family and about the house and kitchen which gives me a clearer insight as to just what sort of a range the prospect should buy.

"But I go even farther than this.

" 'That's fine,' I say to the prospect, after such information has been given me. 'That gives me a pretty good idea of just about what you should have. But to make absolutely sure about the matter I'd like to visit your kitchen and see exactly where you are planning to put the range. It will help me to visualize the situation if it will be possible for me to inspect your kitchen.'

"Here again a favorable impression is made on the prospect because it becomes evident to the prospect that I am taking a deep interest in the possible sale and because it seems evident that I am anxious to see to it that the prospect gets just exactly the range that is best suited to the prospect's needs.

"So I generally find no difficulty in getting the prospect's ready consent to visit the kitchen. And, generally, I go right out to the house with the prospect.

"Once in the kitchen I look it over carefully and let the prospect see that I am taking plenty of time making my inspection. I get down on the floor and take measurements, too, and measure heights on the walls and make certain that there is no other place in the kitchen where the range could be more satisfactorily located.

"Of course, I have my catalogue with me, and after making my inspection and putting my figures on paper together with the data about the size of the family, I turn to some particular page in the catalogue and show the picture of a good range to the prospect and then say something like this:

The Proper Range Needed

"'This is the range I'd advise you to buy. This range will fit perfectly into the space you've provided for it and it is just the right size for taking care of your family comfortably and easily. If you built a range to order I don't believe you could get anything that would be more suitable for your specifications—size of space and size of family being considered.'

"Of course, after I've gone to all this trouble of taking measurements and inspecting the kitchen and getting data on the size of the family, the prospect is quite curious to see the kind of a range I advise buying. So the prospect gives attention to the range I recommend.

"Generally the range I suggest is higher in price than the prospect has been contemplating puchasing, according to the statements already made to me. There's a psychological reason for recommending a higher priced range—a reason that helps me in putting sales across.

"I've found that many prospective purchasers of ranges say to themselves that they'll see what they can do for some certain price and if they can't get a range for that price they'll be willing to go a little higher. In their hearts the prospects feel that they won't be satisfied with a cheaper range. In their hearts they feel that the higher price is what they should pay.

Sale Made Easier

"So when I recommend a higher priced range to prospects than the price they've said they wanted to pay, I'm doing something that convinces the prospects that they were right when they contemplated paying the larger sum for a range. And so, because this makes them feel satisfied with themselves and with their judgment, it is easier for me to put the sale of the range across.

"All this means, then, that with hard sales I go to a lot of fuss and bother so as to make a favorable impression on the prospect and convince them that I'm selling a range to them on a really scientific basis which, frankly, is what I feel I am doing. And all this, too, gives me a rather novel talking point that is of the greatest sort of help to me in putting difficult sales across."

Interesting, isn't it?

And aren't there some worthwhile ideas and suggestions in all this that other gas range salesmen can use to good advantage in their businesses in making more sales?

SELLING GAS VS. SELLING SERVICE

It has often been said that the gas company is in business to sell gas, the butcher to sell meat, and the baker bread. If meat is meat, and bread is bread, why is it that some butchers and some bakers do a better and larger business than their neighbor tradesman? The same would apply to gas companies if two or more would be allowed to sell gas to the same home.

Gas may be gas, but "Utility is the prerequisite of value, for nobody will give anything in exchange for what nobody wants." Here arises the question: What is the utility or value of gas? The value of gas to the customer is what you have taught him it should be.

A company supplying public service, although privately owned, is a public servant. Its services do not end with supplying gas of specified B.t.u. value. at a certain pressure, but extend into the field of instructing the customer to get the best service out of the gas he buys. Herein lies the success of any gas company, by increasing the utility, and thereby the value of the gas they manufacture. There is perhaps no business that offers greater opportunity of doing this, than the gas business in its commercial department.

"During 1925," according to Roger W. Babson, "there were sold 800,000 new gas ranges, 450,000 gas water heaters, and 500,000 gas space heaters. The new heating load developed by all these uses far exceeds the old lighting load lost to the electric companies."

The gas appliance salesman who sells gas appliances that prove to be of best service to the customer is the gas company's best business builder. The salesman who sells warm rooms rather than gas heaters and the conveniences of an abundance of hot water as well as the use of hot water, is a public servant indeed.

Such conception is not philanthropic; nor is it altruistic. It is sound business vision carried out for profit, the profit of the investors in the gas company's securities as well as of the community.—The Gas Appliance Salesman.

¤ ¤ ¤ ¤

NATURAL GAS CUSTOMERS INCREASE 92,000 IN 1925

Domestic consumers of natural gas in 1925 increased 92,000, or almost three per cent over the year before, according to a report of the United States Bureau of Mines, says the Pennsylvania Public Service Information Committee. That brings the total of domestic consumers up to 3,356,000.

Indicative of better utilization of that fuel, it is worthy of note that while the number of domestic users was increasing, the amount of domestic consumption in cubic feet was decreasing about five per cent in the same period of time.

Interstate transportation of natural gas, carried on mainly for domestic consumption, increased in 1925. The industry is working to preserve the supply, and to that end is urging the customer to eliminate all wasteful usage.

A Study of Some Gas Analyses and the Relation of the Components

C. W. Stevens

THE average coal gas manufacturing plant, using coals that vary but little in composition, working constantly under given conditions, with very slight fluctuations of operations, produces a very uniform product. The daily analysis of gas, as well as other products, will run practically the same day in and day out. The procedure is so routine that any deviation is suspected of being an error of laboratory analysis, and a thorough investigation is made before an operating fault is accepted.

This is emphatically the case of the manufactured gas. It must be so, for any change in the analysis would so vary the quality that it might disarrange the normal operation of the consumers' appliances. Gas equipment being somewhat sensitive and in turn carefully adjusted, any radical variation of gas quality may cause it to cease functioning. For this reason gas companies keep most rigid watch over the composition and heat value of their gas.

The writer has carefully studied the analysis sheets for a period of six months, taking note of variations in composition and the effect upon the components and qualities of coke oven gas. It seems that there is a distinct relationship between the various components of the gas; a definite ratio of these to themselves and the resultant properties.

Any change in the analysis affects the entire relationship in precise manner, within certain limits. The "variables" of the gas vary in proportion.

Effect of Air Infiltration

For example, suppose there is a slight infiltration of air. There is an increased percentage of oxygen and nitrogen, not only lowering the other ingredients, hydrogen, methane, etc., but having a definite effect upon the specific gravity and heat value of the gas.

Or suppose that a change occurred in the carbonization process, the coking time was increased, or the gasification temperature lowered. Such changes would affect the composition of the gas. If the hydrogen content increases, the percentage of methane will decrease, and the other components and properties will change accordingly.

Or if excessive suction is applied to the flues of a coke plant, and flue gases drawn into the coke oven gas, it will result in high carbon dioxide and nitrogen, with a definite effect upon the other components and the specific gravity and heat value as well. Hence, a change of any part of the gas affects the relationship of the gas constituents and properties accordingly.

Daily Analysis Graphically Shown

Fig. 1, 2 and 3 represent the daily analysis of the gas produced in a coke plant over a period of five months. The major constituents as well as the specific gravity and heat value are plotted, giving a graphical study of the variation in quality of the gas. The effects of such variation stand out clearly on all the components and properties.

Some of the gases contained have very little variation, such as carbon monoxide, illuminants, oxygen, carbon dioxide, due to the fact that normal changes in carbonization practice affect these but little. Their percentage is so small that normal fluctuations are not detected. External changes, such as infiltration of air or flue gases, contact with water or solvents, etc., might affect these minor components, such as oxygen or carbon dioxide, but such external leaks or irregularities are rare. Practically all variations in gas composition come from the method of carbonization or character of coal.

What the Charts Show

A study of these operating charts shows clearly how the peaks or dips of one of the major ingredients affect the others. For example, a rise in the percentage of hydrogen is usually accompanied by a corresponding drop in methane as well as nitrogen content. At the same time the specific gravity is lowered while the heat value is greater. Or an increase in nitrogen, such as occurred on November 27, due per-

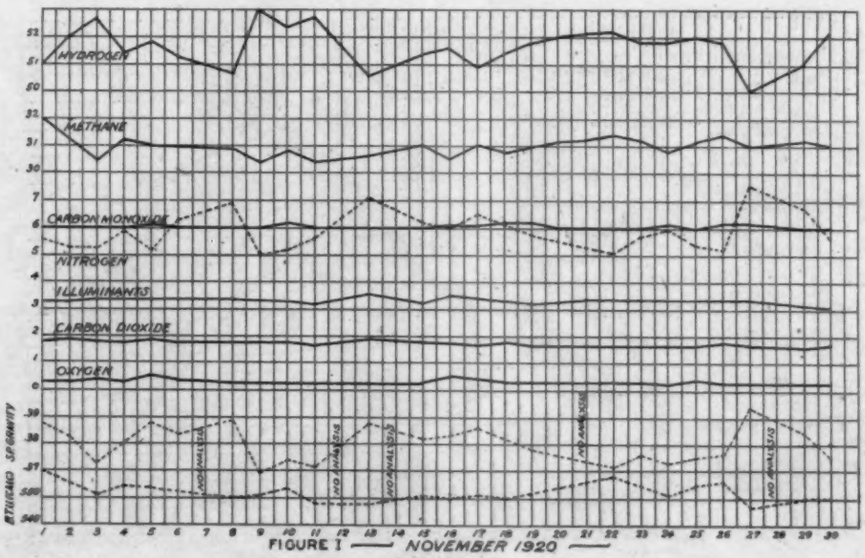

HYDROGEN
METHANE
CARBON MONOXIDE
NITROGEN
ILLUMINANTS
CARBON DIOXIDE
OXYGEN
B.T.U. GAS
SP. GRAVITY
NO ANALYSIS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

FIGURE 1 — NOVEMBER 1920 —

haps to infiltration, lowered all these major components and the heat value, but caused a rise in the specific gravity.

From these apparently associated fluctuations an attempt was made to show a distinct relationship between these major constituents and properties of the gas. The results were plotted on the accompanying curves, Figs. 4, 5, 6 and 7; the apparent harmony was surprising.

The specific gravity was chosen for the independent variable, abscissae, on these curves, as the basis of comparison, as it is very readily obtained and is a fundamental property of the gas. The curves show the relation that exists between the specific gravity and the other properties. In this manner there exists a common vehicle for comparison, and the relation between the various components can be instantly obtained without the necessity of so many curves.

The heat value would make a very good general basis for the comparison, as it also has a summation property, affected by every component of the gas, and changes of any of these affects the heat value accordingly. It is a function of the combination of gases.

But that is a matter of choice. The important point is that for given operating conditions on a given plant there exists a definite relationship between the components and properties of the gas produced.

This relationship will vary with different plants, with unlike conditions of operation, different coals and methods of carbonization, and so on, so that each plant will have its own gas expectation. Curves could be plotted for each plant that will cover its own conditions. Those of one plant will not apply to others.

The Curves, Figs. 4, 5, 6 and 7, show the relation of the heat value in B.t.u. per cubic foot, per cent hydrogen, per cent nitrogen, and per cent methane, respectively, to the specific gravity of the gas.

The "x's" indicate the actual analyses. The curves were drawn smoothly through these points and give a very close approximation of actual occurrence.

FIGURE II

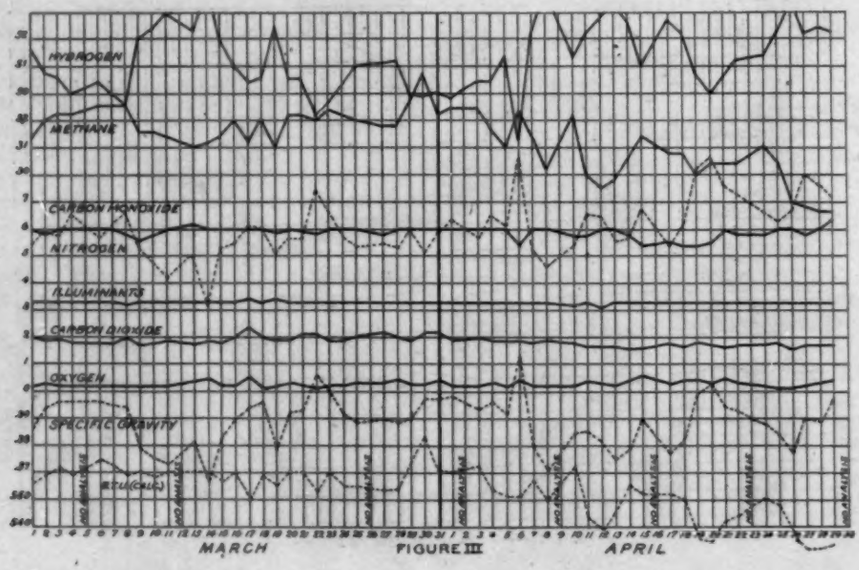


FIGURE III

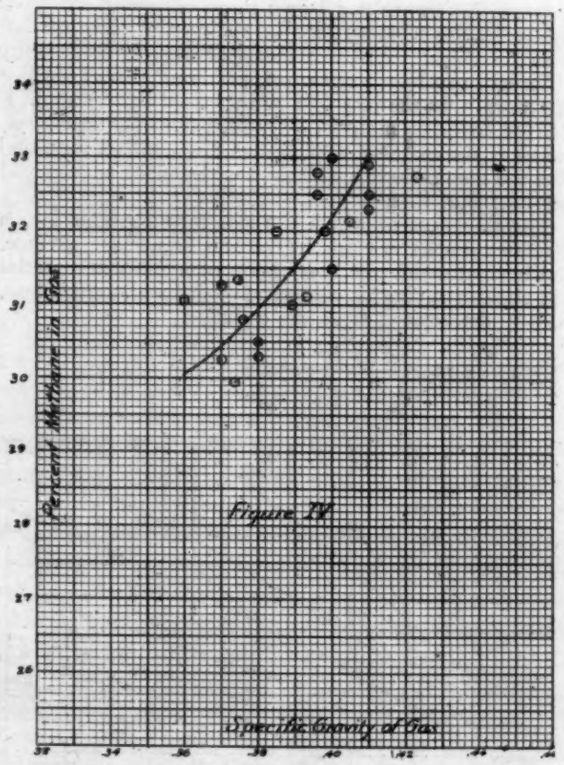


Figure III

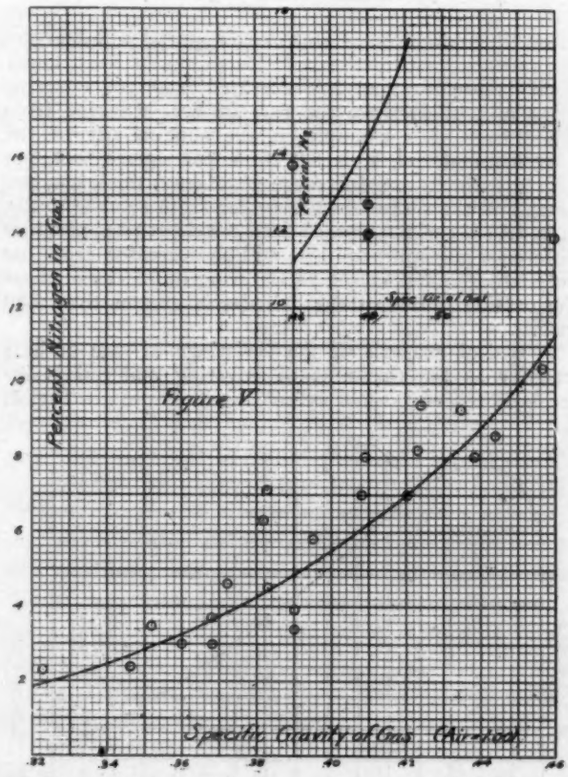


Figure V

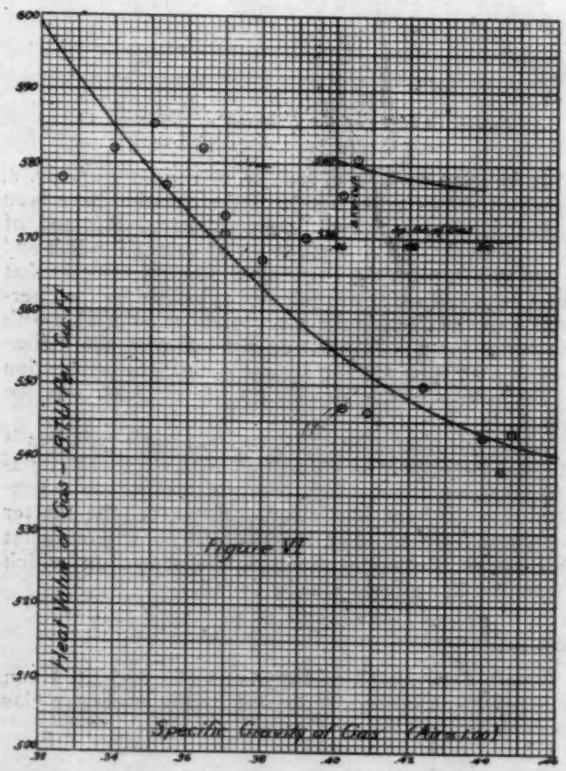


Figure VI

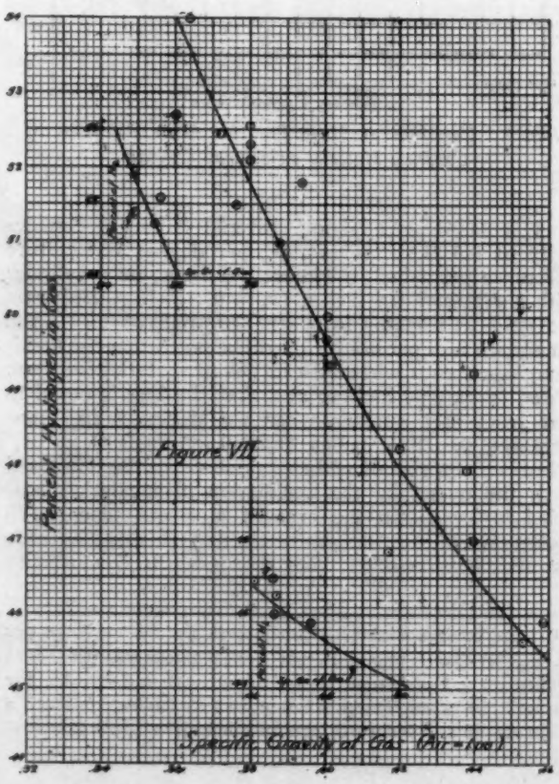


Figure VII

(Continued from page 105)

after which addition of still more material will decrease the rates of heat transfer. If the radius of the cylinder itself is greater than k/c the application of covering material will decrease the rate of heat transfer from the outset. For example, if the conductivity of the covering material, k, is 0.2 B.t.u. per square foot, per degree temperature difference per 1-inch thickness, per hour, and the rate of heat transfer from surface to air, c, is 1.67 B.t.u. per square foot per degree temperature difference per hour, the loss will be decreased from the outset by the application of covering in all cases where the outside radius of the cylinder is greater than 0.30 inch.

A typical example of the variations of rate of heat transfer as the thickness of covering material is increased on a very small cylinder is illustrated in Fig. 5.

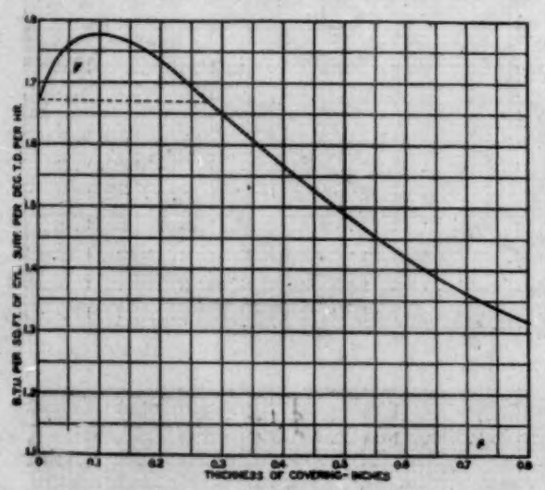


Fig. 5. Variation of Heat Transfer With Thickness of Covering Material on a Small Cylinder.

This is based on applying material having a conductivity of 0.5 B.t.u. per sq. ft., per degree temperature difference per 1-inch thickness, per hour, on a cylinder with a diameter 0.4 inches ($r_1 = 0.2$ inches) and on a rate of heat transfer from surface to air of 1.67 B.t.u. per square foot per hour. It will be noted that the maximum loss occurs when 0.10 inches of material has been added ($r_2 = 0.30$ inches) and that the loss is equal to that from bare surface when the thickness has been increased to 0.285 inches ($r_2 = 0.485$ inches).

For a given size of cylinder the loss will be decreased from the outset by the application of insulation provided $k < cr_2$. In the case of a 1-inch pipe, 1.315 inches actual outside diameter, and if $c = 1.67$, the loss will be decreased from the outset if conductivity is less than 1.10 B.t.u. per square foot, per degree temperature difference per 1-inch thickness per hour. The conductivities of most good insulating materials are less than 1.0 B.t.u. per square foot, per degree temperature difference per 1-inch thickness, per hour[1]. It is obvious therefore, that the loss will be increased by the application of covering material *only on extremely small cylinders* if the material applied has low conductivity, and that the application of sufficient additional material will decrease that loss.

The thickness at which the loss through material on a small cylinder is equal to the loss from bare surface, and beyond which the application of additional material will show a saving as compared with bare surface loss, may be determined from the equation

$$\frac{r_2}{R_s k} = \frac{r_2 - r_1}{r_1 \log_e \frac{r_2}{r_1}} \qquad (10)$$

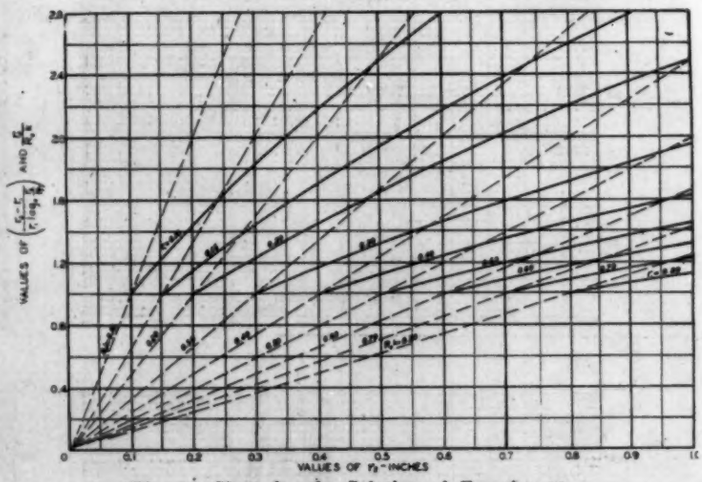


Fig. 6. Chart for the Solution of Equation 10.

This equation may be solved through the use of Fig. 6, in which values of each side of the equation have been plotted against r_2 for different values of $R_s k$ and of r_1 respectively. With a given set of values for $R_s k$ and r_1 the loss through the covering will be the same as that from bare surface at the value of r_2 located by the intersection of the line for the appropriate value of $R_s k$ with the curve for r_1. If these do not intersect, the indication is that r_1 is sufficiently large that the application of the given material would decrease the loss from the outset.

While this discussion of losses from small cylinders is of great importance in connection with electrical insulation on wires, it is of little practical importance in connection with heat insulation. However, the matter has been covered fully in order to show just what determines the upper limit of diameters on which these peculiar effects will be found.

(To be continued in the Feb. 5th issue)

[1] If the covering material is concrete ($k = 6.258$ B.t.u. per sq. ft., per deg. temp. diff. per 1-inch thickness, per hour) applied on a 3-inch pipe ($r_1 = 1.75$ inches) and $c = 2.0$, the loss will be a maximum when $r_2 = 3.12$ inches, or after a thickness of 1.37 inches of concrete has been applied.

Note:—Derivations of Equations (9) and (10) can be supplied on receipt of request by the American Gas Journal.

As The Journal Views It

A PAPER OF "PARTS"

There seems to be a tendency for many of us to give a wide berth to those affairs in life which involve the expenditures of more than the average amount of time and effort required for their successful handling. In a sense the most of us will devise short cuts and trump up quick, if not wholly reliable, methods of accomplishing some end particularly when the problem assumes a proportion but a trifle out of the ordinary. We do not like to dig in very deeply. We rather skip over the tough spots with a minimum of effort. Perhaps this is due to the more or less superficial aspects of the age in which we are living. Or possibly—speaking of the engineering profession—it is chargeable to a throwback, as it were, to the days when we first came to grips with the study of Physics.

Many engineers can hark back to their days of regular prescribed study. Days when the larger percentage avidly devoured and digested such trifling formulae as Ohm's Law and other such elementary tidbits. At the same time they will no doubt recall with what feeling of ennui they tackled equations and formulated rules dealing with the radiation and convection of heat. These latter were the rough spots and generally speaking they received but scant consideration. It took too much time.

The laws involving the transfer of heat are concerned with a rather complicated subject. But it is not a wholly mysterious and abstruse study if one will but take the time and energy to dig down somewhere near the bottom. There must be no attempts at short cuts. There must be no skipping over the tough spots. The formulae outlining the laws of the action of heat in so far as radiation and the like are concerned are not simple by any means. They are giants compared to Ohm's Law. They require vigorous, concentrated study for their mastery.

Dr. McMillan's admirable paper, the first portion of which makes its appearance in this issue, is not recommended for reading to those who would race through it double-quick. It was not written by one who is in the habit of tackling an engineering or scientific problem by the "hop-skip-and-jump" method. It is generously "interlarded" with formulae and equations—many of them refreshingly new and to the point—of a complicated, but conquerable, sort. To those who will exercise a modicum of patience and concentration in their reading of a scientific treatise we can promise a treat by way of Dr. McMillan's paper. They will not only derive a scholarly pleasure, so to speak, from the reading of this paper but, mark you, will store up no mean supply of data and knowledge which can be put to a very practical use. They will amass some facts that if properly applied will be reflected in dollars and cents savings in the operation of their plant or solution of their particular engineering problem.

In this and the two following installments many of us will encounter and, we hope, absorb some entirely new ideas; matters which set forth the true meaning of Conductivity, the significance of Surface Resistance, the effect of air velocity on heat transfer, the fact that surface temperature is no satisfactory measure of heat transfer and the result of the economic analysis.

The subject of insulation is always an important one. It is concerned with the saving or loss of thousands of dollars worth of heat throughout the entire world. We believe that a painstaking study of Dr. McMillan's paper will ably assist some in placing much of this money on the proper side of the ledger.

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ASSOCIATION ACTIVITIES

Starting with the present issue of the American Gas Journal we propose devoting a page to the activities of the American Gas Association.

From time to time the various committees of the A. G. A. hold their meetings in different sections of the country and some of their members go to considerable expense and trouble in order to be in attendance. It is upon such men that much of the future of the industry depends; make no mistake on that score. We feel that their efforts are worthy of mention in the American Gas Journal.

House Heating With Gas*

Some interesting details on house heating in Concord

A. J. Smith

Manager, Concord Gas Company, Concord, New Hampshire

AT the present time there are twenty-nine gas fired house heating installations in operation in Concord.

During the short experience that we have had with house heating, we have found that no hard and fast rules can be laid down as yet for this type of gas service. We find that each individual prospect has to be handled independently and according to the surrounding conditions. These conditions vary as much from each other in the same community as gas situations vary in the different cities.

Most of our sales originate from inquiries as to the practical use of gas for house heating purposes, or for a special rate applying to heating installations. In addition to those who inquire about gas to heat their homes, are many who would be interested and who would make the change if they were acquainted with the comfort and convenience of gas as compared with coal. If we are to sell gas for house heating purposes, it is our business to locate these persons and acquaint them with the many advantages of the fuel we have to offer.

The Cost

The first question that the interested party asks us is generally, "What will it cost me to heat my house with gas"? This question is answered by stating that we will be glad to make a call at his residence, or place of business, as the case may be, and after a detailed study of his situation we can tell him approximately the amount that it will cost him, providing that he will follow our instructions and advice in regard to the amount of radiation required, the proper insulation of the windows and doors and other matters of this type, in order that he may get the maximum amount of heat service at the minimum cost.

When inquiries are received they are turned over to our new business representative. The representative then calls on the applicant and explains to him or her the gas rate, type of service given, and points out the advantages of gas as applied to the individual prospect's house conditions, and obtains the amount of radiation necessary to heat it. After measuring the present cast-iron radiation, or the house, as the case may be, he informs his prospect that he will prepare an estimate covering the customer's installation and operating costs, and will call again to go over the various features or questions arising from the customer.

Letter Detailing Cost

Particularly do we wish the customer to understand, and if possible, fully appreciate the cost of operation before he places his order, so we generally submit a letter something like the following:

Dear Sir:

As the result of our Mr. Brown's investigation, we are pleased to give you the following quotation for heating your residence with gas, based on 660 square feet of hot water radiation:

Installation Cost

One No. 5-W-4 Bryant Automatic Tubular Boiler equipped with metal asbestos jacketed cover, Robertshaw Control and Solenoid Valve, for automatic operation.....$425.

One No. 77 Minneapolis Heat Regulator, with 8 day 7 jewel clock .....$70.

Labor and material necessary to complete connections, including gas, water and flue, also opening street and placing of larger supply line to cellar .....$100.

Total Cost .....$595.

Estimated Operating Cost

For the normal heating season, September 15th to May 15th, 242 days, maintaining a temperature of 70 degrees from 7 a. m. to 10 p. m., and 60 degrees from 10 p. m. to 7 a. m., it is estimated that the gas consumption for the entire heating season will be 550,000 cu. ft., which at our present rates for gas, would be about $495. These costs are carefully calculated, but are not guaranteed. The installation of a gas boiler cannot be guaranteed to correct any faulty circulation or insufficient radiation troubles.

We will be glad to furnish any additional information that you may desire.

Very truly yours,

In arriving at the operating costs we have made a study of weather conditions in Concord for the past number of years, as per data furnished by the local Weather Bureau. The customer is shown that the

(Continued on page 118)

* Presented at meeting of Operator's Section, New England Gas Association, December 19, 1926.

INDUSTRIAL GAS LESSONS

IF IT'S DONE WITH HEAT — YOU CAN DO IT BETTER WITH GAS

Lesson No. 154

Oil Gas

Use of Oil Gas Process

The question naturally arises as to the use of the old gas process. From the very nature of the process and of the raw materials that are used in it, it is evident that oil gas cannot be largely used as a fuel except in those places where oil fuel is very cheap and coal is high. There is no reason for using oil as a gas-making fuel where coal is plentiful and cheap, that is for a primary gas-making process. Hence we find oil gas being made in this country only on the Pacific Coast and perhaps in a city or two elsewhere where oil supplies are plentiful and cheap. There are no coal deposits within reasonable distance of the Pacific Coast and the only cheap and plentiful fuel is oil. Hence it is used to make oil gas which is distributed through the mains just like coal gas and brought into the homes and factories —to some slight extent only in the latter case—and used as a fuel.

But there are certain properties of oil gas and its manufacturing process that make it very attractive as a peak load process. These advantages may be summarized in the following manner. First of all it is possible to build the oil gas plant in very large units with the result that labor charges are very small per unit of gas made. In the second place there is no trouble with ash or clinker in using oil as fuel, which is quite the contrary when coal is used. This is an interesting point in that it is always advanced as an argument by the oil man and by the gas man as well when he is advocating his fuel for house heating purposes or for use in the industrial plant.

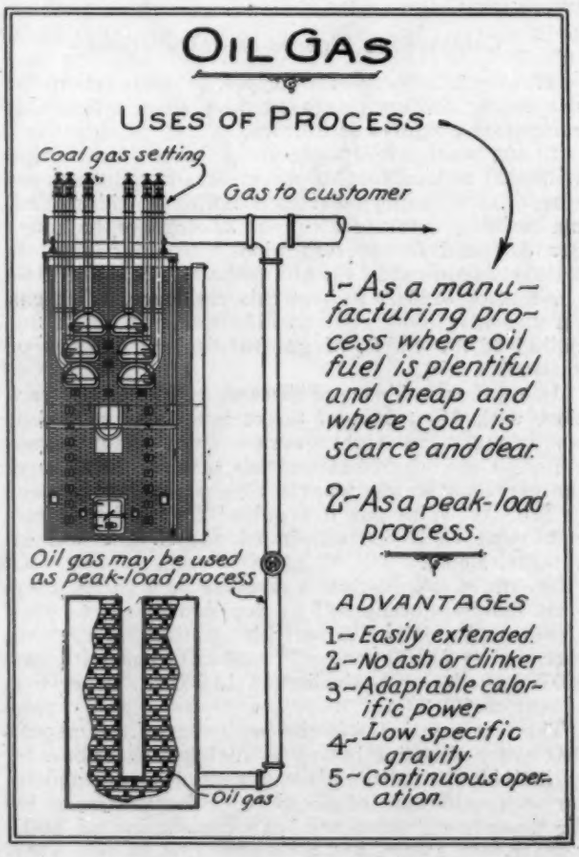
Other Advantages

Then again it is possible to vary the calorific power of the gas made from oil within very wide limits and thus produce a gas which is up to the standards set by the various states. Oil gas made by the Jones process is of lower specific gravity than water gas and hence when mixed with coal gas and distributed through the mains, it has the effect of increasing the capacity of the existing distribution system. The fifth and last advantage is that the oil gas process is an absolutely continuous one and hence it is not necessary to use large holders in plants where it is made.

A Peak Load Process

All these advantages are advanced in favor of oil gas as a peak load making process. This is a very interesting matter, for the gas man always has to take careful consideration of his peak load conditions and have certain plant equipment available for taking care of this load. There are of course different ways of doing this, as for example by having reserve water gas generators or an extra bench or two set aside especially for this purpose. The question is what is the best and most economical way in which to take care of this load and in making his decision —a matter which can be done only after careful study made of all the factors involved—the gas engineer should pay some attention to the claims of the oil gas process.

It must of course be mentioned that oil gas is a comparatively slow burning gas in comparison with water gas and other gases that do not contain a high percentage of hydrocarbons but large amounts of hydrogen and carbon monoxide. Thus when oil gas is used it is necessary to make special adjustment of the shutter on the range and other domestic appliances so that the speed of the gas passing through the burner is not great enough to cause the flame to blow out, due to the fact that the rate of flame propagation is so low.


OIL GAS
USES OF PROCESS
Coal gas setting
Gas to customer
1-As a manufacturing process where oil fuel is plentiful and cheap and where coal is scarce and dear.
2-As a peak-load process.
Oil gas may be used as peak-load process
Oil gas
ADVANTAGES
1-Easily extended.
2-No ash or clinker
3-Adaptable calorific power
4-Low specific gravity
5-Continuous operation.

(Continued from page 116)

three coldest months, December, January and February will require about 60 per cent of the total fuel consumed, and that January is generally the coldest month, using 22 or 23 per cent of the total winter's fuel.

The average fuel requirements per heating season in Concord, and the figures which are used in arriving at the operating costs are 800 cubic feet of gas for each square foot of cast iron hot water radiation, 1,000 cubic feet of gas for each square foot of cast iron vapor radiation, and 1,200 cubic feet of gas for each square foot of cast iron steam radiation.

Our first installations were made in the early summer and fall of 1923, at the period when coal prices were at their peak.

Previous to this time the gas company had been heating their own office building for two years, and the writer had tried it himself at his own residence for a like period. This had given us some practical experience which we applied to our first installations.

One is both fortunate and unfortunate in having the opportunity of conducting experiments in his own home with an automatic heating machine. He is fortunate because he can live a life of ease, while the miners go on a strike and the thermostat stokes the fire. He is unfortunate because he usually is suspected, due to the opportunity given of conducting the experiment, of being biased or prejudiced in his opinion.

Comparative Figures on Installations

Three entirely different types of installations in use during the entire season gave some interesting comparative figures as follows:

In one residence of three-story frame construction with 800 square feet of direct steam radiation, an eleven section Bryant steam boiler was installed, maintaining a temperature of 72 degrees 15 hours per day and 65 degrees nine hours per day. It formerly required 22 tons of anthracite coal at $18.00 per ton, or $396.00 to heat this residence. With gas for the season it required 714,700 cu. ft., or it required 32,487 cu. ft. of gas to displace one ton of anthracite coal.

In another residence of three-story frame construction, with 845 sq. ft. of direct hot water radiation, we installed an eight section Bryant hot water boiler. The cost of heating this residence with coal the previous season was 16 tons at $18.00 per ton, or $288.00. With gas it required 555,000 cu. ft., or equivalent to 34,700 cu. ft. of gas to one ton of anthracite coal.

The third installation was made in a three-story brick building, occupied by a department store. This was a steam job. Formerly it required 40 tons of soft coal at $12.00 per ton, or $480.00, and with gas 530,000 cu. ft., or equivalent to 13,260 cu. ft per ton of soft coal.

The fact mentioned in the beginning of this paper, that every situation has to be analyzed according to its individual condition, is emphasized by the widely varying conditions of these three installations. In the department store we have a radiation of 1,600 square feet, steam, and a consumption of only 530,000 cu. ft., against a consumption of 714,000 cu. ft., in one of the other residences and a radiation of only 800 square feet, steam. There is always a reason for these variations, and it takes considerable time and study to determine them when the original estimate is made. The dry goods store, taking out holidays, weekly half-holidays and Sundays, was operating on a five-day week, also maintained a temperature of only 68, as this is considered high enough for a store. The two residences showed about 75 per cent increase over the price of coal, while the store was only 38 per cent over the price of coal. This shows the reason why we believe in being cautious in giving figures to consumers before studying their particular situation.

Location of Thermostat

In selecting the proper location for the thermostat, in order that a uniform temperature may be maintained in all rooms, we have made use of recording thermometers, placing the thermometer in various rooms for twenty-four hours, thus determining the proper location for the best twenty-four hour temperature service.

In regard to the service that we give our installations, I would say that during the first year, with only three installations, we made an inspection every day of each installation for the entire season in order to watch closely all conditions, and at the present time we are making weekly calls. During these calls we wind the clock on the thermostat, inspect the water line in the boiler, and give any other necessary service, so that the consumer has practically nothing to do, and we find that this service is very much appreciated. We place a printed card near each boiler, giving telephone numbers of three of our inspectors, any one of whom may be reached if any service is needed day or night.

Three of our largest installations happen to be situated on the same street and next to each other on a four inch main. In order to determine any drop in street main pressure during the peak consumption hours of these boilers, we installed recording pressure gauges on the houses on either side, and found that there was no drop in the main pressure at the hours of maximum use of the three boilers. Each installation has a separate 2-inch service and a separate meter.

Another interesting fact that we have noticed is that the gas consumption through the twenty-nine meters operating our gas boilers, during the months of December, January and February, is three times that obtained through five hundred ordinary prepayment meters which we happen to have in use.

When we first started, during the heating season of 1923-24, we had a heating rate of $1.15 net per thousand cubic feet.

During the year 1924 we put into effect a rate which was used in the season of 1924-25, and since then as follows:

	Gross	Discount	Net
First 100 cu. ft. per month ..	$2.10	.10	$2.00
Next 2,900 cu. ft. per month .	1.10	.10	1.00
Over 3,000 cu. ft. per month .	.95	.10	.85

(Continued on page 121)

GAS MERCHANDISING

Domestic – Industrial

Ideas for the Man Who Sells

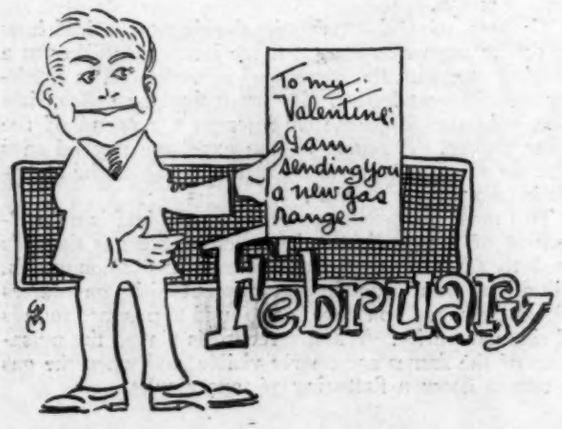
William H. Matlack

HERE AND THERE IN SELLING

Window Display Suggestion for February

Here is a suggestion for a window display to be used along about the 10th of February. This display is designed to tie into St. Valentine's day and to show the advantages of the Gasco range. The large card tells why the up-to-the-minute kitchen has adopted the Gasco Range and the small

cards, four in number, are lettered; "No pot washing, No burnt biscuits, No danger, No excessive use of fuel." The smaller cards are cut in the shape of hearts and to each is attached a red ribbon which in turn is attached to the larger card which forms a part of the background of the window. The large card tells what the Gasco Range means to the home-manager.



WHAT BECOMES OF THE VAST ARMY OF RETAILERS?

There Are Not Too Many Retailers—But Too Few Who Conduct Retailing Scientifically

There is a yelp and yowell on every side of poor distribution—added cost by reason of too many retailers, although here and there are found men who have as yet failed to agree that the high cost of distribution may be attributed to the fact that there are too many retailers. Some of these men agree that the casual observer will naturally attribute much of the waste and duplication in distribution to the fact that there seems to be an over-abundance of retail stores. They maintain, however, if one is enough interested to dig deeper, that much of the talk in regard to the number of retail failures utterly ignores the vital fact contained in any authoritative statistical report. These reports clearly indicate that the high mortality of retailers is largely chargeable to haphazard, time-worn methods, to the fact that too many retailers just happen to get into business. They also indicate that there is room for the present number of retailers (population, buying power and area considered) and that they would be able to decrease the cost of distribution if their stores were conducted scientifically. Thus it is the opinion of many men that there are not too many retailers but that there are too many men in the business of distribution who have no conception of the functions of retailing.

Not long ago we were talking to a man regarding retail merchandising, as it is largely conducted today, about the number of new merchants continuously appearing upon the scene and how quickly many of them disappear, "fold their tents and silently wander away," over-night.

"Mercantile agencies and other authorities say that the mortality of retail merchants in all lines reaches a staggering percentage," remarked this man, "and I would like to know when this order of things will change? I am interested from the consumer's standpoint, for I realize that the greater the number of retail failures, the higher will be the cost of distribution, which means the higher the ultimate cost of merchandise to me, the consumer.

"When will men become better merchandisers?

"What is to bring about the change, are some of the questions I have been asking myself," said he.

We have pondered over the same question many times and as we view the operations of many so-

called retail merchants we are led to believe that time alone will correct the evil, to a great extent—never entirely. However, along with others we maintain the opinion that there are not too many retailers—but too many untrained retailers. Yet there is hope, for all about us is evidence of more scientific buying, advertising and selling, in all retail lines. Too, "Time, the tomb builder" will help bring about the desired and necessary change; yes, Time, or shall we say the age limit, is slowly and silently, yet effectively, working, at this very moment, to that end.

Time Will Help Conditions

Time is the potent force at work, the element that is playing a part along with manufacturers, jobbers, dealers and associations. Together these agencies will eventually bring about the change that is so essential to correct the present-day systems of many retailers. This action will have the effect of decreasing the mortality rate and percentage, cut the cost of distribution and go far toward fixing a reasonable resale price, increasing production and stimulating sales.

Better merchandising comes from a greater knowledge of the scientific principles of merchandise, buying, display, advertising, selling and service, in a full knowledge of the article or service sold and its application in relation to the human equation.

Here, in the greatest country on the face of the earth, the country of rapid transformation and development, we have undergone a phenomenal change with regard to all factors in connection with our being within the short space of a half dozen years, and while a great many folks have not or never will be able to adjust themselves to the new standards, modes and methods every sensible thinking business man realizes that this is the beginning of a new merchandising era. He realizes that orders taken on a bombastic basis are not to be considered as healthy sales nor that do they approach anything like an ascending sales curve year over year.

There has come upon us a vast sweeping change in human relations—the development in transportation alone has affected our mode of living very extensively. Urban dwelling has increased by leaps and bounds over-crowding cities, necessitating the development of so-named efficiency apartments, labor saving devices by the hundred and affecting a thousand and one other phases of human existence.

Some Have Tuned-in

Those merchants who lack the ability or initiative to quickly adjust and adapt themselves to this new order of things are the ones who are floundering about and crying wolf, wolf, wolf, and who will continue to do so until time counts them out. While the fellow who quickly adapted his methods to suit the times, tuned in, has very little to complain about.

Education, understanding, has broadened our sphere of living, and advanced it, and notwithstanding the occasional whine to the effect that the home in America is rapidly passing out of existence on all sides, in every nook and corner of this vast country folks are purchasing better things to live with. Whole families now work for the common good of one establishment, their home, and in many industrial cities there may be found four, six or eight wage earners dwelling under the same roof, as members of one family. All of these folks have money and, being constantly thrown into society, cannot help but acquire a knowledge of the comforts of life, the conveniences of others and as quickly demand the new things they see and learn of for themselves.

Who Then Will Survive?

There are many factors in connection with living today that clearly indicate to anyone the least observant that the "store-keeping as father did" is out of order.

Merchants who school themselves to the knowledge and who are able to look at conditions and times, human needs and desires in an analytical manner, investigating each and every factor entering into merchandising without prejudice, caused by precedent, delving into them, dealing simply with facts, factors and laws as they affect human relations today and proceed with the thought that nothing is fixed except the fluctuating movement in merchandising—will be the successful ones.

The merchant who senses and quickly tunes in with the times is going to survive and prosper, while he who does not will be counted out, for scientific merchandising, buying, advertising and selling has come to stay and grow. No difference what may be said about new-fangled ideas, successful merchandising is scientific merchandising, and as we view it, it is not a problem of cutting down the number of retail merchants but of building up stronger and more efficient merchandising methods through the co-operative efforts of manufacturer, jobber, dealer and dealer associations all working on a fully reciprocative basis with the full knowledge that each is necessary to the other and that only through correlated effort can they hope to attain any degree of efficiency or satisfaction.

Secrecy and stealth are spent—reciprocation is rife and responsible for the rapid rise of retailing.

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GAS FLAME TEACHES DEAF THE ALPHABET

An ordinary gas flame is being successfully used to teach deaf and dumb children the sound of the various letters of the alphabet, according to an announcement from London.

The new method consists in showing each child how he or she can make the gas flame jump and flicker at a varying rate with the current of air produced in speaking the different letters. By producing the appropriate change in the flame the child learns the sound of the letter spoken. A report on the gas-flame method says that the average pupil can learn the letters of the alphabet in about three months.

This means of teaching sounds to the deaf is a development of recent discoveries whereby the gas flame is used to soften and transmit sounds in a phonograph. Vibrations from a diaphragm transmitted by gas flames within the sound box have been found to produce sounds of singular purity. When a record is played the pulsations of the flames are clearly visible, and when the gas is turned down a flattening of tone results.

(Continued from page 118)

Minimum charge for heating season of $150.00.

This rate returned, for the season of 1924-25 an average revenue of 90 cents per thousand for all gas sold for house heating.

Advantage of Thermostat

We have taken many interesting charts showing the temperatures maintained in the various residences that we are heating, and it is surprising to see the uniformity of these temperatures when under the control of a thermostat. One of our customers, who is particularly enthusiastic about gas heating, has a chart taken in his home when the outside temperature was 26 degrees below zero in the morning, and never went above about 15 below for the day. This chart shows that his room temperature did not vary more than one degree from 70 all day, and from 65 during the night. This customer keeps this chart on his desk in his office, and proudly shows it to people who come in. He also claims that his household has been practically free from winter colds since this even temperature has been maintained in his residence.

We believe that the best way to advertise house heating is by issuing a booklet showing the residences that are actually being heated locally, and giving other information, which the local consumer can see for himself.

Among the interesting booklets of this type, which the writer has noticed are:

"The Story of the Invisible Fireman" issued by the Denver Gas and Electric Company.

"Heat Your Home With Gas" by the Kansas City Gas Company, and a booklet entitled, "Dedicated to the Discerning Women of Portland," issued by the Portland Gas & Coke Company, Portland, Oregon.

We have recently issued a booklet along these same lines, entitled "Warmth and Comfort Conveniently," and believe it has done us a great deal of good locally. In addition to this we have each installation photographed, showing the residence and the heating system, and keep a large portfolio in our office of these actual installations. On these photographs we show cost of actual operation, and prospective customers may find a residence among those already heated, which very nearly matches their own in size etc., which gives them a fair idea what the cost may be in their own particular case.

Insulation

During the past year there has been built in Concord three residences which have been insulated with Armstrong's cork-board. These three houses are all to be heated with gas. Two of these houses will be heated only part of this season, as they are not quite completed, but the other one started heating on September 5th, and we will have a complete record at the end of this season on the cost of heating a well built insulated residence. The cost of heating this residence up to December 1st of this year has been 25 per cent less than we would have estimated for the same if it had been uninsulated. Temperatures taken in this residence during the coldest day in December, when the outside temperature was about ten above zero showed a uniform temperature of 72 degrees in the second story, while the attic remained at 26 degrees all day. This shows the very small heat loss, through the cork-board on the second story ceiling.

Conclusion

To sum up our situation:

We believe that gas heating is with us to stay, and that as time goes on the demand for this service from our customers will increase.

We think that, owing to the fact that other classes of business, like department stores, offices, clubs, churches (other than residential), can be secured. The diversity in these classes of business will improve the heating load factor.

We think that rates will adjust themselves as we grow in experience.

There will be more insulated houses built in the future, and they will be ideal to heat with gas.

And to emphasize again that, as conditions are not the same in any two localities, the question of the desirability of supplying gas house heating, and the rates to be given, can be determined only from a study of local conditions.

OTHER THINGS THAN FUEL KEEP THE MODERN BUILDING WARM

Many things besides fuel help to keep modern homes warm in the coldest months. These include seaweed, sugar-cane, hair, minerals and wood in other forms than fuel. Instead of installing a furnace that will provide more heat, builders nowadays blanket a house on the inner surface to keep the cold out.

Some builders use a woolly-looking material, made of wood with its fibres broken down and rebuilt into a soft, fluffy form; it has the natural insulating efficiency of wood many times multiplied. Another material looks like furniture stuffing, being made of short, matted cattle hair inclosed in sheets of waterproof paper. Or seaweed may take the place of hair. Still another material looks like building board, but it is made of sugar-cane.

Use of Gypsum

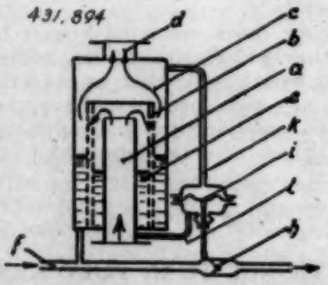
Another insulating material consists of gypsum ground to a fine powder, mixed with water and poured between walls. The addition of water results in the formation of a gas, which expands the mixture to three or four times its original bulk, producing myriads of tiny air cells, each inclosed in a gypsum wall. These air cells give the material its insulating properties. Hair, seaweed and the like possess such air cells naturally, and the value of any of them as an insulator depends upon the number of such air cells in a given area of the covering.

It has been estimated that the use of such blankets as these may mean one-third heat conservation.

PROGRESS IN GAS TECHNOLOGY
Domestic and Foreign

TAR SEPARATOR WITH VARYING LIQUID LEVEL

THE illustration shows a tar separator in which the level of the liquid varies. The inlet for gas is shown at a, and b is a perforated inverted hollow cylinder which is fastened tightly to the housing of the separator. The liquid seal is shown at e. The gas enters in the direction of the arrow through a and passes through the perforated cylinder and thus reaches the outer space c and moves thence



into the gas main through the outlet d. The liquid seal liquor enters through the tube f in a constant stream and flows off after passing by the check valve h. The latter is regulated by means of controlling membrane. The pressure in the space c acts on the upper side of the membrane i, this pressure being transmitted to it through the tube k, while the lower membrane is connected through the pipe h with the gas inlet. If the pressure differential is increased, whether it is due to the increase in the flow of gas or because of contraction, or filling of the perforations in the inverted cylinder, then the membrane i is pressed upwards and the check valve h is opened and more water is allowed to flow through the separator. German Patent No. 431,894.

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DETERMINING FREE SULPHUR IN SPENT OXIDE

GLASS tubes of 25 millimeters internal diameter whose cylindrical portion is 15 centimeters long and which are drawn out into a five centimeter long point; ending in an oblique opening of two millimeters internal diameter, are used in the determination of sulphur in the spent oxide. The entire tube has an over-all length of approximately 20 centimeters and the volumetric capacity is 60 cubic centimeters.

A hundred gram sample is taken from the spent oxide and heated to 80 degrees C in a drying oven until it attains constant weight and the water content is figured from the loss in weight. The dried sample is now very finely powdered and screened through a screen with 30 meshes per linear centimeter, hence 900 meshes per square centimeter.

A wad is then placed in one of the aforementioned glass tubes and then five grams of Norite carbon are added so that the substance is evenly distributed and then ten grams of the sample are added on top of the carbon. The tube is fastened in a clamp and a glass crystallizing vessel of about 100 cubic centimeters capacity is placed under the tube, this vessel having first been weighed.

Carbon disulphide is now allowed to run into the tube until it is full. The liquid passes through the spent oxide, dissolves out the sulphur, then passes through the carbon where the tar and oil are retained and after a quarter of an hour has passed it commences to drop out of the tube. The wad of cotton prevents the carbon from dropping out of the tube. All of the carbon disulphide is allowed to run out of the tube and then it is filled again with fresh liquid. In all about 150 cubic centimeters of the carbon disulphide are used which is sufficient for complete removal of the sulphur contained in the spent oxide. The test is started in the afternoon and the dish containing the extracted sulphur can be left over night and in the morning it will be found that the carbon disulphide has evaporated leaving pure sulphur behind. This is dried to constant weight. Das Gas und Wasserfach, 1926, pages 790-1.

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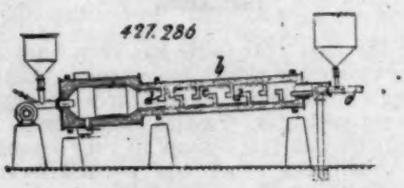
PRODUCER OR WATER GAS

WATER gas or producer gas is made from dusty or powdered coal, lignite, wood, sawdust and the like. The apparatus which is used for this purpose consists of a rotary drumb b, as



shown in the accompanying illustration, of the character that is employed in the cement industry. At one end of this drum a mixture of powdered coal,

air and steam is blown into the apparatus in order to obtain the necessary heat of reaction while at the other end of the drum the fuel is fed through a fuel h, the fuel being in a finely powdered condition. Inasmuch as the drum rotates and is inclined at an angle, the reduced fuel travels in a direction opposite to the flow of the hot combustion gases. Thus as the coking of fuel progresses and hence as it becomes more active, it continues forward into hotter zones in the apparatus, so that the heat of reaction increases with decrease in activity of the material. The gas outlet is shown at o, while the cross-walls are shown at c. German Patent No. 427,286.

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ACTIVATED CHARCOAL AS A GAS ADSORBENT

O. L. Barnebey filed an application August 2, 1920, upon which Patent No. 1,608,155 was issued November 23, 1926, dealing with the use of activated charcoal for adsorbing gas at atmospheric pressures and using such charcoal for the storage and transportation of the gas. The gas once adsorbed is held at all atmospheric temperatures and at atmospheric pressure and gives off the gas again when heated to temperatures ranging substantially above the range of atmospheric temperatures.

While other materials have been used for adsorbing gas for the purpose of storage and transportation, in granting the patent the view is expressed that the substitution of activated carbon for material having the adsorptive capacity of activated carbon for ordinary charcoal was not an obvious thing to do. Rather, the substitution involved discovery of new and unexpected qualities of the substituted material, as there was nothing known about the material to indicate that activated charcoal after adsorbing gas at atmospheric pressure would hold the gas so adsorbed at all ordinary atmospheric temperatures and yet give it up if heated to certain higher temperatures.—Industrial and Engineering Chemistry.

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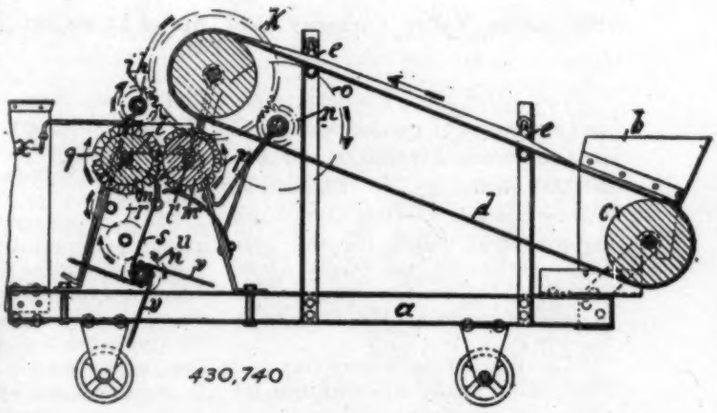
A NEW LABORATORY TABLE TOP

A highly efficient laboratory table top, recently designed by F. R. Greene, 439 Fifth Avenue, New York, has been given the name "Ebolab" from its inlaid working surface, Johns-Manville asbestos ebony.

Recent tests have shown that this material, a homogeneous mineral compound of asbestos fiber and binding cement, with a general physical appearance of ebony or hard rubber, is remarkably resistant to the action of the common acids and strong alkalies, as well as many of the common reagents in use in the laboratory, including permanganate of potash, hydrogen sulfide, and phenol. The inlay is embedded in a black acid-, fire-, and waterproof cement by hydraulic pressure on a five-ply laminated backing and bound by a chemically treated molding to prevent warping and shrinking. All the joints are ground and processed to prevent penetration of moisture, acids, fumes, etc., which also gives invisible joints and the appearance and service of a continuous surface.—Industrial and Engineering Chemistry.

REVIVIFYING SPENT OXIDE

AN apparatus and process used for revivifying spent purifier mass is described in German Patent No. 430,740 and is shown in the accompanying illustration. The apparatus is mounted on wheels and can be moved around from place to place



Thus it has a truck to which wheels are fastened. One side of the truck holds the loading hopper b in which the roll c turns and around which the transporting belt d runs. This belt is elastic and also runs over another pulley on the other side of the truck. The elastic nature of the belt allows the conveyed material to remain in its sunken middle portion without danger of falling out. The belt is driven by means of a motor or it may be turned by hand.

The fly wheels turns on the shaft h supported in proper bearings and carrying as well the gear wheel into which another gear wheel k meshes, the latter also rotating on the shaft. At the delivery end of the belt a there is arranged a system of crushing rollers m and m^1, which are rotated on two shafts l and l^1, which are driven by means of the intermediary gear wheels n and o through the gear wheels p and q which are located on the shafts l and l^1. The gear wheel q transfers the motion through the gear wheels r and s on to a gear wheel u which sits fast on the shaft, which carries the arms v of a centrifugal device. A water nozzle x is arranged over the outlet from the centrifugal device and this nozzle is under control so that the proper amount of water can flow through it.

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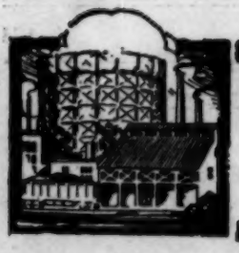
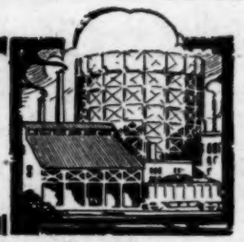
THIS IS A REAL GAS MAIN

Chicago has a gas main four feet in diameter and twenty-two miles long. It consists of 9,500 twelve-foot sections, each weighing four tons, and cost $4,500,000. Its capacity at ordinary pressure is 100,000,000 cubic feet of gas every twenty-four hours.



NEWS OF THE GAS INDUSTRY



Gas Firm to Make Big Improvements

Blackstone Valley Company Will Spend $4,000,000 on Work This Year

Providence, R. I.—Betterment and extension of service which will cost between $4,000,000 and $4,500,000 will be the Blackstone Valley Gas and Electric Company's improvement policy for the year 1927, according to David Daly, president of the company. The statement made by Mr. Daly is as follows:

"The Blackstone Valley Gas and Electric Company will continue its policy of extension and improvement in the year 1927 as it has done the preceding years.

"We have confidence in the industrial future in the Blackstone Valley and we are backing up that confidence by increasing investments each year; while not all of the 1927 improvement programme has been approved by the board of directors, it is safe to assume that we shall spend in the Blackstone Valley, that is Pawtucket, Woonsocket and the intervening towns, and in our share of improvement at the Somerset station of the Montaup Electric Company between four million and four and a half million.

"This programme covers additional generative capacity at the Somerset station of the Montaup Electric Company, a new coal gas plant at the Tidewater Works in Pawtucket, a second high pressure gas main between Pawtucket and Woonsocket and a number of other major improvements.

"This great additional investment by this company is made to take care of the future growth of the business. This growth, principally, comes from the industries of the Blackstone Valley.

"We consider these investments the best evidence of our faith in the industrial future of the Blackstone Valley, which means the business futures of the cities of Pawtucket and Woonsocket and the intervening territory."

Connersville Blower Co. Opens Sales Office

A sales office for this company has been opened in Pittsburgh, the office to be located in Room 604, Chamber of Commerce Building, and to be in charge of Mr. Bernard C. O'Brien, who formerly represented the blower company in that city but who for the past few years has been in charge of the company's office in New York City.

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Valuation Sought By Two Gas Firms

Washington, D. C.—A deficiency item of $55,000 was sent to the Budget Bureau by the Public Utilities Commission to provide for a valuation of the two gas companies and a study of the telephone company's depreciation charges.

Of this amount, $50,000 is for a new valuation of the properties of the Washington and Georgetown Gas Light Companies.

The last valuation of these companies was made in 1916 when their total value was set at about $10,000,000. They are valued now by the commission at about $16,000,000 due to additions made since 1916.

The companies made a request for revaluation last year but the commission has had no funds with which to undertake it. A request was made at the last session of Congress to have the cost paid by the companies, but was not allowed.

The gas companies claim their present valuation is too low. An increase would mean an increase in rates for consumers.

Gas for Balloons

Denver, Col.—Denver was expecting to hold the Gordon Bennett international balloon races in the mile-high city next July, as one of the features of the opening of the Moffat tunnel, but investigations by a committee brings forth the report that balloons require pure coal gas; that the gas as manufactured in Denver consists of two-thirds oil and water, only one-third coal gas.

* * *

GAS FINANCING LIKELY

Consolidated Expected to Come Into Market for Funds to Expand Plant Facilities

New York City.—Public financing by Consolidated Gas Co. of at least part of its huge expenditures for new and additional plant facilities is considered a likely development in bond quarters.

Like other large public utilities, Consolidated Gas has to keep building to match the growth of population and demand for gas and electricity in its territory. Too, the need for additional facilities entails sums much larger than surplus earnings can provide. Expenditures for new facilities in 1926 ran close to $70,000,000, and in 1925 were in excess of $57,000,000.

Form of new financing is not yet decided, but it is likely to include some common stock for stockholders' subscription. Last previous offering of common stock in 1923 was at $50 a share. Any additional stock to be offered would be at a price to represent valuable rights to stockholders.

In addition, there is likely to be some sort of a senior security issued, but whether it will take the form of a debenture or a preferred stock is not yet determined.

Issuance of new securities, when it is decided upon, would first be brought before the Public Service Commission for approval.

Gas Plant Is Four Years Old, Now Supplies Wide Territory

Elmira, N. Y.—The E. W., L. & R. R. Co. is celebrating an anniversary, the fourth birthday of the local gas plant, which has been under the direction of Superintendent Thomas B. Williams since it was first put into operation.

After Elmirans had suffered from low pressure of natural gas during the winter months, it was decided to construct a gas making plant. This was completed and the first high-pressure gas turned into the mains, December 14, 1922. Because stoves and other appliances were not adjusted for the burning of manufactured gas, it was several weeks before utilities company employees completed all adjustments in thousands of appliances.

With the increased facilities for making gas, the company began extension of lines and today homes in West Elmira, Elmira Heights and Horseheads have been piped for gas, with other lines now being laid to other suburbs. Many homes are now heated by gas furnaces and there has been a steady increase in the use of gas at industrial plants.

Mr. Williams, who has charge of the plant, came to Elmira in 1922, assisted in the construction of the plant and was then made its superintendent. He is a graduate of the Georgia School of Technology where he studied electrical engineering, obtaining a degree. It is his duty to see that the product of the plant meets the standards required by the Public Service Commission as to heat units and purity.

* * *

Public Service Commission Adjourns

Albany, N. Y.—The Public Service Commission adjourned to an indefinite date, at the request of the parties interested the hearing scheduled before it in the petition of the Adirondack Power & Light Corporation for increased gas rates in the city of Saratoga Springs.

Mayor Asks Expert on Gas Franchise

Notifies Council Problem Is Too Technical to Be Attempted Without Consultation

Minneapolis, Minn.—Mayor George E. Leach served notice on the city council that he will approve no franchise with the Minneapolis Gas Light Company unless it is framed with the advice of a gas franchise expert.

Members of the council gas committee, beginning discussion of a proposal for a new franchise, have indicated they believe they can settle the matter without hiring an expensive expert. The mayor, however, declared the problem is one too technical to be attempted without consulting an expert.

His letter said:

"It has come to my attention that during the sessions of the committee considering a new gas franchise several aldermen represented themselves as being opposed to hiring outside experts to advise the city relative to the terms of such a franchise. I am also advised that the city engineer and the city attorney have been requested to bring the valuation down to date. I need not say that I have entire confidence in these two officials—and the city's interests will be fully protected in any matters entrusted to them.

"But you are aware that the drawing of a long term franchise involves more than purely legal and engineering questions. It is a highly technical matter requiring especial experience and training. This is so well recognized that citizens do not attempt to tie themselves up to a long term contract without having the advice of specialists. You will recall that former councils have always retained the best talent available to assist in the settlement of gas problems.

"I trust therefore that your honorable body will take steps to secure expert advice in this matter, believing as I do that the city's interests cannot be safeguarded in any other way.

"I could not approve any proposed franchise that did not have the indorsement of a competent gas franchise expert."

NO OFFER HERE BY KOPPERS CO.

C. L. & P. Co. Officials Deny Considering Gas Contract

Meriden.—Officials of the Connecticut Light & Power Company, which purchased the Meriden Gas Light Company, denied state reports that they are considering a contract from the Koppers Company of Pittsburgh, Pa., which recently purchased the New Haven Gas Light Company, to furnish gas for the local plant. They said that only recently they considerably improved the local plant and that as yet no offer had been made by the Koppers Company.

The Connecticut Light & Power officials said that the Koppers Company was preparing to go before the legislature and request the right to lay lines throughout the state to furnish gas from a central plant in New Haven to practically all communities in the state. They said that eventually the project undoubtedly will come to pass.

The question of whether gas will be purchased from Meriden from the Koppers Company, the Connecticut Light & Power Company officials said, would depend entirely upon the terms offered by the Koppers Company and the latter would have to show that the gas could be purchased as cheap or cheaper than it can be manufactured in the local plant.

The Koppers Company is said to plan a pipe line from New Haven through Hamden, Cheshire, Southington, Meriden, Berlin, Newington to Hartford and another south from New Haven to Bridgeport.

Would Authorize Gas and Electric Companies to Merge

Boston, Mass.—Senator Alfred M. Bessett of New Bedford filed a bill on petition of Charles H. Hodskinson of Boston, to authorize electric companies to make and sell gas and to acquire the property of and consolidate with gas companies. The measure is designed to meet the situation which came up a year ago when the Worcester Electric Light Company sought to absorb the gas company of that city, but was forced to obtain special legislation.

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Sale of Bangor and Roseto Gas Companies

Bangor, Pa.—Announcement has been made of the sale of the Bangor and Roseto Gas Companies, of Bangor, Pa., to the W. B. Foshay Company, of Minneapolis, Minn. It is understood that they will take possession of the property about January 25. The plant will be operated as the Peoples Utilities Pennsylvania Corporation, and it is expected that this will form one of a chain of properties in Pennsylvania that they expect to acquire.

The property at Bangor was purchased from S. B. Thompson, the vice-president and general manager, who held the controlling interest. Mr. Thompson came from Stroudsburg to Bangor several years ago, and took over the operating of the property, which at that time was badly in need of repairs and extensions. Under his management the plant was rebuilt and several hundred new meters were added. About four years ago, Mr. Thompson acquired the entire stock of the Bangor Company. The plant has been operating under a very liberal policy to the public, and successfully from a financial standpoint.

* * *

Gas Rate Boost Rehearing Asked

Los Angeles, Cal.— The Southern California Gas Co. petitioned the State Railroad Commission for a rehearing on its recent request for an increase in the wholesale rates on natural gas in Los Angeles and vicinity according to a dispatch from San Francisco. The commission ruled against the company on December 29.

The company now wants to increase the wholesale rate on natural gas served to the Los Angles Gas and Electric Corporation to not less than 19½ cents a thousand feet, claiming that the increase is necessary to provide proper returns on their investment.

The Los Angeles Gas and Electric Corporation served notice on the commission yesterday that it would begin the service of straight natural gas to its consumers on January 26.

Steps Taken to Regulate Gas Heaters

Every Appliance Would Have Flue

Hartford, Conn.— An ordinance requiring a check-up and inspection of gas water heaters in the city was approved by the ordinance committee of the common council.

The act was proposed by Building Supervisor Philip A. Mason who, with Dr. C. P. Botsford, superintendent of the board of health, believes that several deaths from gas poisoning which have occurred within the past year could have been prevented by the existence of such a law.

Rulings Well Defined

Under the proposed ordinance all retailers of gas water heaters in the city would be licensed. All appliances of this nature would have to be approved by the American Gas Association Testing Laboratories. All gas heaters and certain other specified appliances would be inspected by employees of the public utilities corporation supplying gas, who would be required to report violations to the building supervisor of the city.

"Eighteen deaths from accidental gas poisoning have occurred in the city during the past year of which twelve probably would have been prevented had this ordinance been in effect" Dr. Botsford told the committee. Of this number three deaths were caused by poisoning from partially burned gas, and fifteen were due to leaking gas." Several specific cases were cited, including the Mather street example in which two members of one family were killed by poisoning from gas.

Mason Outlines Law

Mr. Mason explained in detail the steps called for by proposed law. Incidentally, Mr. Mason again took exception to the verdict of the committee of doctors of the city who pronounced the deaths of Brooks Parker and his infant daughter, due to carbon dioxide, and stated that unquestionably the deaths were caused from monoxide poisoning.

Ernest E. Eysenbach, vice-president and general manger of the Hartford Gas Company, said that his company would be only too glad to meet the requirements of such an ordinance.

"We are willing to go all the way with the city officials to prevent these avoidable deaths that have occurred in the city." Mr. Eysenbach said.

In New Haven the gas company had undertaken the work of inspection on its own initiative, Mr. Eysenbach told the committee.

The expense in connecting present gas heaters with flues in most cases would not run more than a few dollars, it was said. When this expense was offered by one of the committeemen as a possible objection, another member said "If I voted against this amendment and a death occurred in the future which this bill would have prevented, I could never prevent myself from feeling partially responsible."

Deland Vote Gives Gas Plant Charter

Deland, Fla.—Extension of the time limit for the beginning of work on the gas plant was authorized in an election here in which the voting was light. This election gives the Hydro Carbon Gas Recovery Company, of New York, right to begin immediate work on the erection of the gas plant.

Engineers of the company are here and workmen are arriving in large numbers.

GAS DEMAND TOO GREAT FOR PLANT

Company Forced to Operate Own Plant to Augment By-Products Supply

Chattanooga, Tenn.—Demand for gas in Chattanooga has grown so steadily that it may be necessary for the Chattanooga Gas Company to operate its own gas plant to augment the supply of gas received from the Chattanooga Coke and Gas Company plant, which is now a part of the Tennessee Products Company, according to a statement by Manager A. J. Goss of the gas company.

Mr. Goss stated that the gas plant of his company which had been closed down for some time is being fired and placed in readiness to produce gas. The company plans to make a small amount of gas and if the demand continues as heavily as it has been recently it will be necessary to operate the Eleventh street gas plant.

Mr. Goss points out that the use of gas in Chattanooga has grown so steadily that requirements about equal the maximum capacity of the coke ovens and it is natural that all previous records should be broken and the peak load be reached during the cold weather of the past few days. This is because gas is being used for heating to a greater extent than ever before.

Ovens At Capacity

The consumption of gas here has reached slightly better than 2,500,000 cubic feet every twenty-four hours. An official of the coke company explained that the ovens are operating at their full capacity with the exception of one oven which is out undergoing repairs. This oven will be back in service shortly.

So far as can be learned the company owning the coke plant is not contemplating any immediate enlargements to the Alton Park plant, although this will undoubtedly ultimately be done. It will mean that the gas company may have to operate its own plant to augment the supply for some time. Mr. Goss stated that no extensive improvements to the gas plant are needed or contemplated at the present time.

He expressed the hope that the demand for gas in Chattanooga will continue to grow until the business next summer will about equal the present consumption. The company is going ahead with its extension and improvement program during 1927. The budget calls for an expenditure of from $200,000 to $250,000.

* * *

Seymour Gas Heater

J. F. Ryan & Co., 342 Madison avenue, New York, are introducing a new type of gas room heater. It is constructed with a perforated outside shell, allowing free circulation of heated air. The flame is of the Bunsen Burner type and strikes an unperforated steel baffle plate near the top of the heater forming a "curtain of flame," giving an intense heat and causing complete combustion of all gases.

The radiation of heat is through the sides rather than through the top of the heater.

The flame is completely protected by the outside perforated shell so that there is no danger of igniting articles which may come near it. The top is designed for use in heating water.

Complete descriptive matter sent on request.

* * *

Semet-Solvay Engineering Corporation

New York.—Announcement was recently made of the formation of the Semet-Solvay Engineering Corporation. The new company is a consolidation of the Steere Engineering Company and the Engineering and Construction Departments of the Semet-Solvay Company.

Over a period of several years, improvements have been made by the Semet-Solvay Company in the design of coke ovens and auxiliary apparatus, resulting in operation efficiencies not before obtained.

To fill the need for such service in this field, the improvements in design and operating practices, combined with the experience, facilities and personnel of the two organizations, are now made available for the coke and gas industries.

Mr. Frank W. Steere, as vice-president, will have associated with him in the new company those men who have so ably assisted the Steere Engineering Company in serving the gas industry in the past, and the entire technical, research, engineering and construction personnel of the Semet-Solvay Company.

The combined experience and resources of the two organizations permit a degree of service so entirely complete that the new company is in a position to supply every need that modern conditions require of the manufactured gas and coke oven industries.

* * *

Brooklyn, N. Y.—Students of Evening School number 15, State and Schermerhorn streets, recently considered the food industry of Brooklyn, and were addressed by Theodore B. J. Merkt, industrial engineer of the Brooklyn Union Gas Company.

"Last year," said Mr. Merkt, "over $150,000,000 in food products were manufactured in Brooklyn."

"In this stupendous industry, gas fuel plays a very important part. Always ready, it adds its constant, controllable and reliable heat to the many various operations, which make the food industries of Brooklyn of such value and importance, not only to residents of this Borough but to those of the country at large, and other countries as well."

The speaker then told of the ever increasing importance of the kitchen in the home.

Throughout the talk many views were shown of scenes in various food manufacturing plants, hotels, restaurants and public institutions.

A. G. A. ACTIVITIES

Mid-West Sales Council of Commercial Section, A. G. A., Holds Meeting

A meeting of the Mid-West Sales Council of the Commercial Section, American Gas Association, was held at Peoples Gas Building, Chicago, Illinois, Monday, January 17. 1927.

The chairman called upon each individual for his opinion of the value of regional gas sales conferences in general, and especially as to advisability of holding such a conference in the Middle-West during 1927.

All present were agreed that regional sales conferences are a valuable and worthwhile means of stimulating gas company selling efforts for two principal reasons viz:

1. Regional conferences made possible very specific discussions of definite sales methods found effective in the territory in question.

2. Attendance at regional conferences is possible for many sales assistants and salesmen, who do not regularly attend the conventions of the National Association.

Conference to Be Held

With these purposes in mind it was agreed that a carefully planned conference should be held in the Mid-West, the same to be held on February 16, 17 and 18.

It was agreed that the states of Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, and Wisconsin constituted a logical Mid-West group from a territorial standpoint and that Chicago was the best place to hold the conference.

It was felt that the subjects discussed should, for the present, be confined to the sale of gas for household purposes, including house heating. It was decided that all speakers on the program should be directly connected with the gas industry, and that each speaker should be chosen for the outstanding record made by his company in merchandising gas and gas appliances of the variety which he will discuss. The papers presented, (refrigeration excepted) will not be general discussions telling how to sell gas for the various household purposes but will tell how gas appliances and gas have been and are being successfully sold for these purposes in Mid-West communities where the gas company has done an especially good sales job on the particular appliance under discussion.

Major Topics Decided Upon

The major topics decided upon, were Central House Heating, Auxiliary Heating (including Garage Heating), Selling Gas to Prospective Home Builders, Water Heating, Laundry Equipment, Incineration, and Sales of Blue Star Approved Appliances, Selling Gas Ranges, and the Relation of Home Service Thereto, Refrigeration, Supervising Salesmen and Sales Methods, Window and Store Displays as an Aid to Sales.

Each paper on one of these topics will be followed by thirty minutes or more of discussion.

After lengthy discussion of speakers for main topics the program here attached was agreed upon and the chairman was authorized to close any assignments left open at the conclusion of the day's meeting and arrange for pertinent discussions of each topic.

Bearing in mind the number of younger men it is hoped will attend the conference, it was felt by all present that if possible the address of welcome should be made by Mr. Samuel Insull, Jr., himself a young man, whose ideas on the opportunities for young men in the gas industry would at once prove an inspiration to all present.

Other miscellaneous subjects which were suggested to the chairman for discussion of the conferences were:

1. Lack of educational training of individual salesmen.
2. Filing systems for all sales purposes.
3. Promotional rates designed primarily to increase the sale of gas.
4. Ways and means of eliminating lost time in canvassing.
5. How far is it wise to discuss the advisability of insulating houses in publicity on gas house heating.

The chairman appointed the following committee on program and arrangements: C. A. Luther, chairman; C. H. Light, Geo. C. Klopf, J. G. Learned.

Publicity Committee Appointed

The following committee on publicity was appointed: J. F. Weedon, chairman; H. L. Brown, J. W. West, Jr.

Mr. H. L. Brown was appointed local secretary of the council.

Present: J. E. Davies, chairman; P. D. Warren, vice-chairman; J. W. West, Jr., secretary; J. J. Burns, D. E. Callender, Fred. C. Hoffman, R. O. Jasperson, George C. Klopf, John G. Learned, F. X. Mettenet, C. A. Nash, M. F. North.

By Invitation: W. A. Adams, H. L. Brown, G. C. Carnahan, H. L. Dunavan, T. J. Gallagher, C. H. Light, L. E. Lindsay, C. A. Luther, J. F. Weedon.